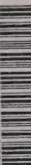


Electronic Services - Los Angeles



M12133X

**DUMONT**

**OSCILLOSCOPE LABORATORIES, INC.**

40 FAIRFIELD PLACE

WEST CALDWELL, NEW JERSEY 07006

TYPES 765-766 SERIES

OSCILLOSCOPES

GENERAL ELECTRIC CO.  
Instrumentation & Control  
228 W. Florence St.  
Inglewood, Calif. 90301



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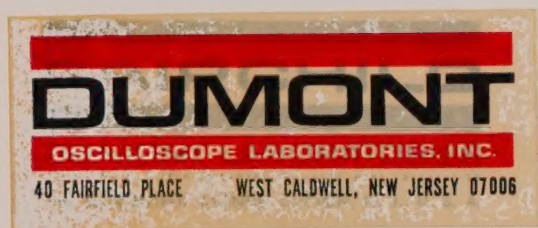
765

SERIES OSCILLOSCOPE

Instruction Manual

Type \_\_\_\_\_

Serial No. \_\_\_\_\_



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# SECTION 1

## TECHNICAL SUMMARY

### 1-1. INTRODUCTION

The Du Mont Type 765 Family of Oscilloscopes consists of an Indicator Unit and any two of a number of available plug-in modules. The Indicator Unit contains the power supplies, a cathode-ray tube with associated circuitry, and an internal amplitude calibrator.

The plug-in modules take the place of the vertical and horizontal deflection systems of a conventional oscilloscope, and their outputs are connected directly to the deflection plates of the cathode-ray tube.

All plug-ins in the 7600 Series are primarily designed for use in the Y cavity of the Type 765 family, while plug-ins in the 7400 Series may be used universally in all the oscilloscopes. The plug-in modules may be selected to give these Du Mont oscilloscopes a degree and type of performance demanded of them by the particular application for which they are to be used.

Section 2 of this manual describes the operation and maintenance of the Indicator units with the modules inserted.

Section 3 of this manual contains the circuit description, trouble-shooting instructions and calibrating procedures for the Indicator units alone.

Section 4 of this manual contains instructions for performance assurance tests to ascertain proper operation and calibration of the Indicator.

Separate manuals are provided for each of the plug-in units. If desired, these manuals may be inserted into the same binder supplied with your Indicator unit.

A Parts List and Schematic diagrams, are located at the rear of each of the manuals.

### 1-2. LIST OF RECOMMENDED ACCESSORIES

| Type or Part Number                     | Description             |
|-----------------------------------------|-------------------------|
| <b>ATTENUATOR PROBES</b>                |                         |
| (10:1 terminated in BNC type connector) |                         |
| 4290                                    | 10M, 10 pf; 4-ft. cable |
| 4298                                    | 10M, 14 pf; 8-ft. cable |
| 4299                                    | 10M, 12 pf; 6-ft. cable |

|                      |                               |
|----------------------|-------------------------------|
| <b>COLOR FILTERS</b> |                               |
| 4800 5861            | Amber for P7 screen           |
| 4800 5862            | Blue for P11 or P7 screen     |
| 4800 5863            | Green for P1, P2 & P31 screen |
| 4800 5864            | Neutral, circularly polarized |
| 4501 0452            | Anti-parallax scale           |

|                                |                                      |
|--------------------------------|--------------------------------------|
| <b>TABLES &amp; RACK SLIDE</b> |                                      |
| 2601-A                         | Movable table, non-adjustable shelf  |
| 2602                           | Movable table, adjustable shelf      |
| 4270                           | Scope traveler, collapsible          |
| 7085                           | Slide drawer (for rack-mounted unit) |

| Type or Part Number      | Description                                                |
|--------------------------|------------------------------------------------------------|
| <b>TERMINAL ADAPTERS</b> |                                                            |
| 7084                     | Male BNC type connector to Type C female adapter, UG-635/U |
| 7080                     | Scope binding post to BNC adapter                          |

|                             |                                  |
|-----------------------------|----------------------------------|
| <b>TERMINATING RESISTOR</b> |                                  |
| 4285                        | 50-ohm, 2-watt, Type C connector |

|                          |              |
|--------------------------|--------------|
| <b>VIEWING ACCESSORY</b> |              |
| 276-C                    | Viewing Hood |

|                      |                                                       |
|----------------------|-------------------------------------------------------|
| <b>CAMERAS</b>       |                                                       |
| 450/450A<br>453/453A | Oscilloscope-Record Cameras with suitable accessories |

|                       |                                                                           |
|-----------------------|---------------------------------------------------------------------------|
| <b>CABLE ASSEMBLY</b> |                                                                           |
| 4294                  | Extension cable for remote operation of the plug-in from the oscilloscope |

|                                  |                        |
|----------------------------------|------------------------|
| <b>OPERATIONAL ACCESSORY KIT</b> |                        |
| 4296                             | Complete kit contains: |

| Qty. | Type  | Description        |
|------|-------|--------------------|
| 1    | 276-C | Viewing Hood       |
| 2    | 4285  | 50-ohm termination |
| 1    | 4290  | Probe              |

|                          |           |                          |
|--------------------------|-----------|--------------------------|
| <b>Terminal Adapters</b> |           |                          |
| 2                        | 4287      | Right angle; UG-306A/U   |
| 2                        | UG-636/U  | C male to BNC female     |
| 2                        | UG-1090/U | BNC to plug tip (banana) |

|                                            |                                        |                           |
|--------------------------------------------|----------------------------------------|---------------------------|
| <b>INTERNAL NO PARALLAX GRATICULE KITS</b> |                                        |                           |
| 7060                                       | For 765/765M/766/767 Oscilloscopes     |                           |
|                                            | <b>CRT Type</b>                        | <b>Internal Graticule</b> |
|                                            | K2257P-                                | illuminated (white)       |
|                                            | K2258P-                                | black                     |
| 7061                                       | For 765H/765MH/766H/767H Oscilloscopes |                           |
|                                            | <b>CRT Type</b>                        | <b>Internal Graticule</b> |
|                                            | KC2316P-                               | illuminated (white)       |
|                                            | KC2317P-                               | black                     |

A schematic of the above kits is shown on the overall high-voltage schematic at the end of the Instruction Manual.

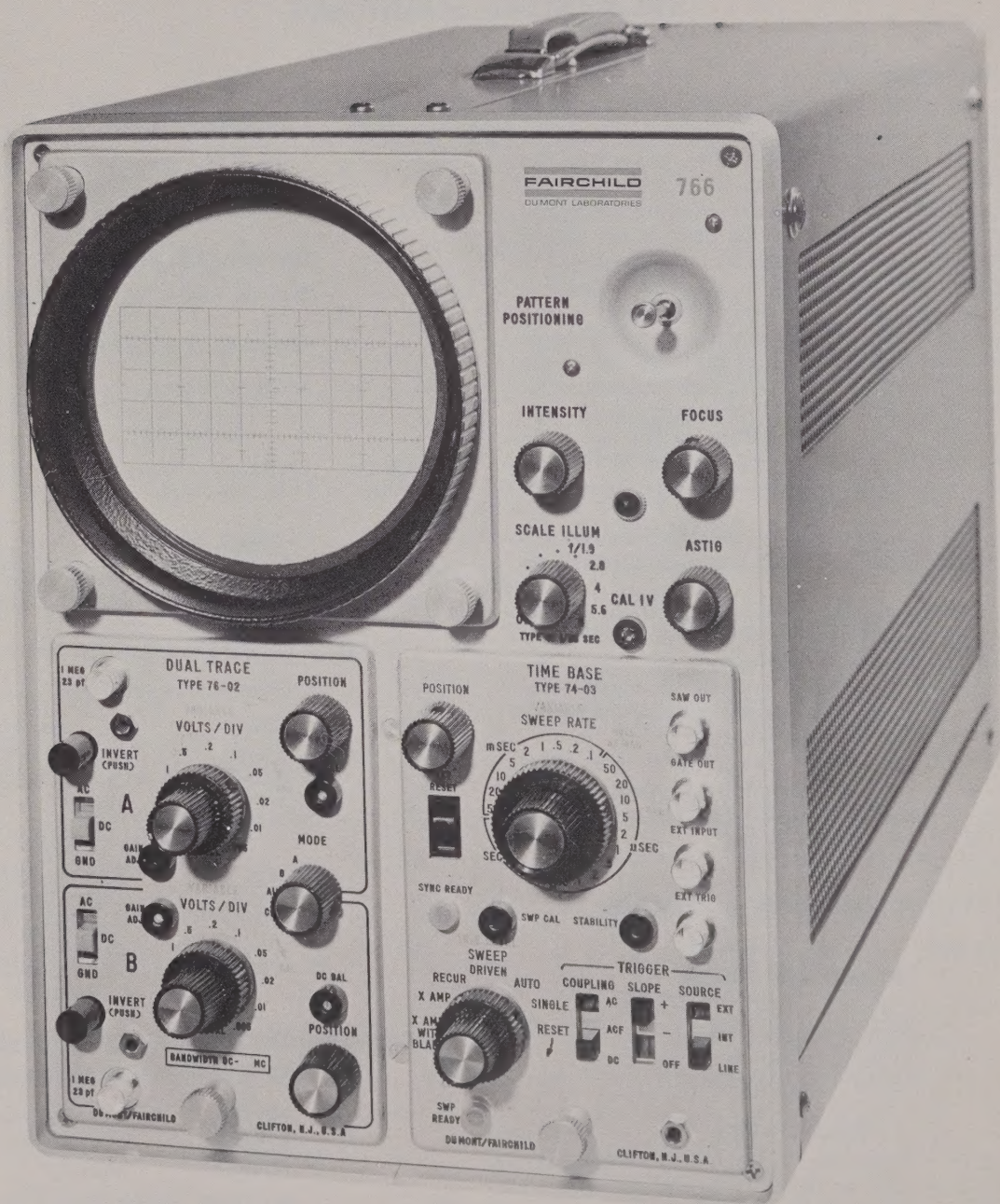


FIGURE 1-1. FAIRCHILD TYPE 766 TRANSISTORIZED OSCILLOSCOPE

# TABLE 1-1

## TECHNICAL SUMMARY

### TYPE 765 FAMILY OF INDICATORS

#### CATHODE-RAY TUBE DATA

|                                                                 |                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type 765 Series .....<br>(765/765M/766/767)                     | Type K2130P-2/B single beam, electrostatic focus and deflection cathode-ray tube is normally supplied. The tube features high-deflection sensitivities, high-writing rate, and a pattern electrode to minimize pattern distortion. Beam gating electrodes are provided to cut off the beam independent of grid Number 1. |
| Type 765 High-Voltage Series .....<br>(765H, 765MH, 766H, 767H) | Type KC2321P-2/B signal beam frame grid electrostatic focus and deflection, cathode-ray tube is normally supplied. Other features are identical to the Type K2130P CRT listed above.                                                                                                                                     |
| Optional Phosphors .....                                        | P1 phosphor for visual use; P7 phosphor for long persistence low frequency or transient observation; P11 phosphor for photographic use; and P2 phosphor for combination visual and photographic use. All other phosphors available on special order.                                                                     |
| Aluminization .....                                             | All tubes are aluminized for maximum light output and to prevent screen charge distortions.                                                                                                                                                                                                                              |
| Over-all Accelerating Potential                                 |                                                                                                                                                                                                                                                                                                                          |
| 765 series .....                                                | 5000 volts                                                                                                                                                                                                                                                                                                               |
| 765H series .....                                               | 13,000 volts                                                                                                                                                                                                                                                                                                             |
| Bezel .....                                                     | Light-proof bezel provides firm mount for an oscilloscope camera and permits ready interchange of filters and scales.                                                                                                                                                                                                    |
| CRT Scale .....                                                 | Engraved edge-lit scale and appropriate color filter over face of tube. Scale illumination control varies illumination level from zero to intensity adequate for photographic recording. Internal no parallax graticule is optional; white scale may be edge lit for photographic recording.                             |
| Display Area .....                                              | 6 cm by 10 cm                                                                                                                                                                                                                                                                                                            |
| Pattern Positioning .....<br>(Type 766/766H only)               | A single lever control (joystick) permits positioning of the display in the horizontal and vertical direction, for registration of the pattern with the scale.                                                                                                                                                           |
| CRT Direct Input (X Axis) .....                                 | Deflection Factor: from 10 volts/cm to 14 volts/cm (horizontal)                                                                                                                                                                                                                                                          |
| CRT Direct Input (Y Axis) .....                                 | Deflection Factor: from 5.2 volts/cm to 7.2 volts/cm (vertical)                                                                                                                                                                                                                                                          |
| CRT Direct Input (Z Axis) .....<br>(766/766H/767/767H only)     | Negative pulse to grid of CRT blanks trace. 25 volts are required into an impedance of approximately 1 megohm coupled via 0.01 $\mu$ f capacitor to dim trace.                                                                                                                                                           |

**TABLE 1-1. TECHNICAL SUMMARY (Continued)**

**VOLTAGE CALIBRATOR**

|                          |                                                                                                                                                                                                                 |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Amplitude .....          | Cal. 1V, peak-to-peak square wave signal available at pin jack on front panel of Main Frame ( $\pm 2\frac{1}{2}\%$ maximum, $\pm 1\%$ nominal); fast rise and fall time permits adjustment of attenuator probe. |
| Frequency .....          | Locked to power-line frequency. This waveform may be used to calibrate the time axis wherever the power-line frequency is a controlled standard.                                                                |
| Access to Plug-ins ..... | The same 1-volt calibrator signal is inserted directly into the input stage of the amplifier plug-in via the attenuator switches to aid in standardizing gain.                                                  |

**POWER SUPPLY**

|                         |                                                                                                                                                     |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Power Requirements      |                                                                                                                                                     |
| Line Voltage .....      | From 105 to 125 volts or from 210 to 250 volts at 60-cycle line.                                                                                    |
| Line Frequency .....    | Operation from 48 through 1000 cycles; line voltage excursion is reduced at extremes of frequency range and where power line distortion exceeds 5%. |
| Power .....             | From 150 to 230 watts depending on the plug-in used.                                                                                                |
| DC Power Supplies ..... | All supplies including the critical tube heaters are electronically regulated.                                                                      |

**ENVIRONMENTAL SPECIFICATIONS**

|                         |                |                               |
|-------------------------|----------------|-------------------------------|
| Temperature Range ..... | 765M/765MH     | 765/766/767<br>765H/766H/767H |
| Operating .....         | -30°C to +50°C | 0°C to +50°C                  |
| Storage .....           | -40°C to +85°C | -40°C to +85°C                |

Note: 765M/765MH; A 200-watt thermostatically controlled standby heater is incorporated for low temperature operation.

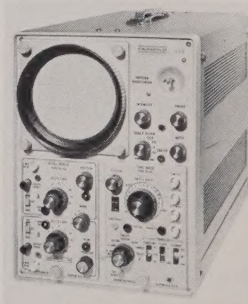
|                      |                          |
|----------------------|--------------------------|
| Altitude Range ..... | Sea level to 15,000 feet |
|----------------------|--------------------------|

**PHYSICAL CHARACTERISTICS (Main Frame)**

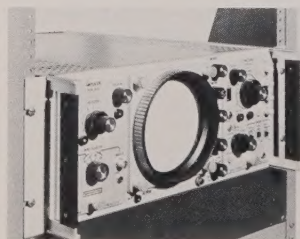
|                 | Portable Models<br>765- | Bench Models<br>766- | Rack-Mounted<br>Model 767- |
|-----------------|-------------------------|----------------------|----------------------------|
| Height          | 8 $\frac{1}{4}$ "       | 13 $\frac{3}{4}$ "   | 7"                         |
| Width           | 17 $\frac{3}{4}$ "      | 9 $\frac{3}{4}$ "    | 19"                        |
| Depth           | 24"                     | 20 $\frac{5}{8}$ "   | 20"*                       |
| Weight          | 18 lbs.                 | 27 lbs.              | 27 lbs.                    |
| Carrying Case   | 9 lbs.                  | .....                | .....                      |
| Shipping Weight | 37 lbs.                 | 37 lbs.              | 37 lbs.                    |

NOTE: A minimum of 2" clearance must be maintained for the rack-mounted model to assure adequate cooling. Do not subject the unit to the hot exhaust air of adjacent equipment.

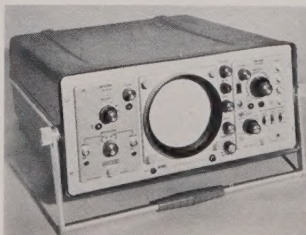
\*Behind panel. With mounting brackets reversed — 18 $\frac{1}{2}$  inches.



Type 766 Bench Model



Type 767 Rack Model



Type 765 PortaScope



Type 765 PortaScope  
with complete Carrying Case

# SECTION 2

## OPERATING INSTRUCTIONS

### 2-1. INTRODUCTION

This section of the Instruction Manual describes the operation and maintenance of the Indicator Unit with the Plug-in modules inserted. Operation of the Indicator Unit with the plug-in modules inserted, is much the same as that of a conventional Du Mont oscilloscope with corresponding vertical and horizontal deflection systems. Full operating instructions for each of the plug-in modules are contained in the manual which accompanies it.

### 2-2. PRELIMINARY INFORMATION

The Indicator Unit contains a low-voltage power supply, a high-voltage power supply and cathode-ray tube circuitry, and a voltage calibrator.

The low-voltage power supply provides regulated and unregulated voltages for application throughout the instrument. The cathode-ray tube circuitry provides the necessary controls and adjustments for presenting a sharp display of the desired intensity for displaying the signals applied to the deflection plates by the plug-in modules.

The voltage calibrator yields a 1-volt peak-to-peak fast rise and fall time square wave signal for use in normalizing the gain of the plug-in amplifier modules and for setting the timing of the time-base plug-in module wherever the power-line frequency is a controlled standard.

### 2-3. POWER REQUIREMENTS

The line transformer in this oscilloscope can be set for either 115-volt or 230-volt operation; a plate on the rear of the instrument specifies the voltage for which your instrument is set. If the instrument is set for 115-volt operation, it will operate properly at any line voltage between 105 and 125 volts at 60 cycles. If it is set for 230-volt operation, it will operate properly at any line voltage between 210 and 250 volts at 60 cycles. Line voltages beyond the limit specified may cause the power supplies to go out of regulation. Power-line voltage excursion will be more limited over the permissible power-line frequency range of 48 to 1000 cycles. Harmonic distortion should not exceed 5%.

If desired, this instrument can be converted from 115-volt operation to 230-volt operation, or vice versa, by merely setting the 115V/230V Selector switch to the desired voltage. Refer to the low-voltage schematic drawing to ascertain the proper fuse to use when instrument is connected to either the 115-volt or 230-volt line.

#### CAUTION

*Do not operate* the oscilloscope on 230-volt mains with the 115V/230V Selector switch set to 115 volts. The fuses may not protect the transistors and diodes from this improper application of double-line voltage.

Although primarily designed to operate at a line frequency between 50 and 60 cycles, this instrument can be operated at any line frequency from 48 cycles to 1000 cycles. However, slightly higher line voltages are required at the higher frequencies.

### 2-4. OPERATING INSTRUCTIONS

Any of the plug-in modules may be inserted in either of the cavities in the front of the instrument. The module on the right controls the horizontal deflection of the beam and the module on the left controls the vertical deflection of the beam. Thus, it is possible to change from a horizontal time sweep to a vertical time sweep merely by changing the position of a time-base module. However, there is no provision for coupling an unblanking pulse from the left hand module to the cathode-ray tube, so when a vertical sweep is used, the trace is not blanked between sweeps. X-Y operation is obtained by using amplifier modules in both oscilloscope cavities. (The right-hand cavity is often referred to in the plug-in manuals as the "X-Axis" cavity; the left-hand cavity is referred to as the "Y-Axis" cavity.) The procedure for making the adjustment on each plug-in is described in its individual manual.

Intensity modulation of the CRT beam is possible through the Z INPUT connector at the rear of the oscilloscope.

To remove a plug-in from the Main Frame, simply unscrew the knurled thumbscrew at center bottom of unit and pull it free of the Main Frame. The plug-in unit is provided with a powerline interlock jumper on its connector, hence all power is automatically disconnected whenever a plug-in is removed.

When you change a module from one cavity of the Indicator Unit to the other, you must adjust the gain of the plug-in unit to allow for the difference in vertical and horizontal sensitivity of the cathode-ray tube. This is accomplished by means of the GAIN ADJ or SWP CAL front-panel screwdriver controls on the plug-in modules and permits normalization of the plug-ins to any Main Frame.

### 2-5. REMOVAL AND REPLACEMENT OF PARTS

If it is necessary to order a replacement component from the factory, always give the Type Number and

Serial Number of the instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in this manual. The Parts List gives the values, tolerances, ratings, and Du Mont part number for all electrical components used in the instrument. This will help to expedite service. Identification of replaceable components are shown in Section 3, Figures 3-2 through 3-5.

The procedure for replacing most parts in this instrument is obvious, therefore specific instructions for their removal are not required.

## 2-6. CATHODE-RAY TUBE REPLACEMENT

To remove the cathode-ray tube, first remove the covers, disconnect the tube socket and the four leads connected at the neck of the tube. Remove the bezel and loosen the tube clamp at the base of the CRT. Pull the cathode-ray tube straight out through the front panel. Be careful not to bend or break the neck pins on the CRT as the tube is removed. Install the new cathode-ray tube by the reverse of the foregoing procedure. Be sure to align the scale to the CRT trace and scan aperture.

After the cathode-ray tube has been replaced, it may be necessary to recalibrate. Special attention should be given to recalibration of the time-base sweep rates and to the amplifier sensitivities.

## 2-7. SERVICING HINTS (Figure 2-1)

This portion of the Instruction Manual is intended to facilitate isolation of trouble occurring within the Main Frame or to one of the plug-in modules.

If the trouble is isolated to one of the plug-in units, refer to the appropriate module manual for further information. If the trouble is confined to the Main Frame, refer to Section 3 of this manual for a list of Test Equipment required and for more detailed information.

In the event of improper equipment performance, the following suggestions are recommended:

1. Remove the side covers and inspect for faulty components. Check the fuses in each power supply buss. Measure the voltages at the test points in the Main Frame. If all the above are within specifications, the problem will most likely be in the plug-ins. It is suggested that other plug-ins known to be operating properly be inserted on a substitution basis. The faulty plug-in is thereby isolated and may now be given remedial attention. Refer to Figure 2-1 for an over-all functional block diagram of the system.

2. Whenever an apparent trouble is pin-pointed, make sure that it is not caused by improper setting of the panel controls. For instance, if the TRIGGER SOURCE, SLOPE, or SOURCE controls are improperly set on the Time-Base Plug-in, then apparent triggering problems are manifested.

3. When using accessory probes or adapters, be

sure the trouble is *not* originating in the accessory, before suspecting the oscilloscope itself.

4. When it has been determined that a specific trouble exists and has been localized to a given circuit within a given unit, then make a visual inspection of that circuit. Many troubles, such as loose wires, scorched parts, may be exposed by this method. Obviously, you should find and eliminate the cause of charred resistors or over-stressed capacitors before replacing damaged component.

5. Localizing the trouble is made easier by use of an oscilloscope to check waveforms. Use a high impedance probe while trouble shooting.

6. Sometimes it may be necessary to move the plug-in unit from one cavity to the other in order to gain access to the particular part of the circuit that requires checking. A Du Mont Type 4294 Extension Cable Accessory is available and permits the plug-in unit to be operated while extended through the front or side of the oscilloscope.

## 2-8. TROUBLE SHOOTING INFORMATION

Frequently, many oscilloscope ailments may be discovered through an erroneous display on the screen or by the conspicuous absence of a display. The information in the paragraphs to follow will pin-point this information according to the symptoms presented to the operator.

### a. A Naked Screen

If the operator is not able to obtain a trace or spot on the screen, substitute other plug-ins known to be operating properly. Adjust the INTENSITY control and observe the screen for a spot on trace. If the screen remains blanked, the trouble is confined to the Indicator or Main Frame Unit. Refer to Section 3 of this Instruction Manual for diagnostic and remedial procedures.

### b. Insufficient Deflection

If the horizontal or vertical deflection signal cannot be set to the proper value with the front-panel screwdriver controls, GAIN ADJ or SWP CAL on the plug-ins, then check the output of the low-voltage regulated supplies at Test Points, TP1001 through TP1004, located on the Main Frame. The high-voltage Test Point is TP2001, also located on the Main Frame chassis. If these voltages check out alright, the trouble resides in one of the plug-ins. If there is insufficient vertical deflection, it is in the left-hand module; if there is insufficient horizontal deflection, it is in the right-hand module. Refer to the appropriate plug-in module Instruction Manual for further information.

### c. Improper Sweep Timing

A front-panel screwdriver control, SWP CAL, is provided on the Time Base Plug-in to permit normalization of this module to any main frame. If this control does not have sufficient range, then check the output

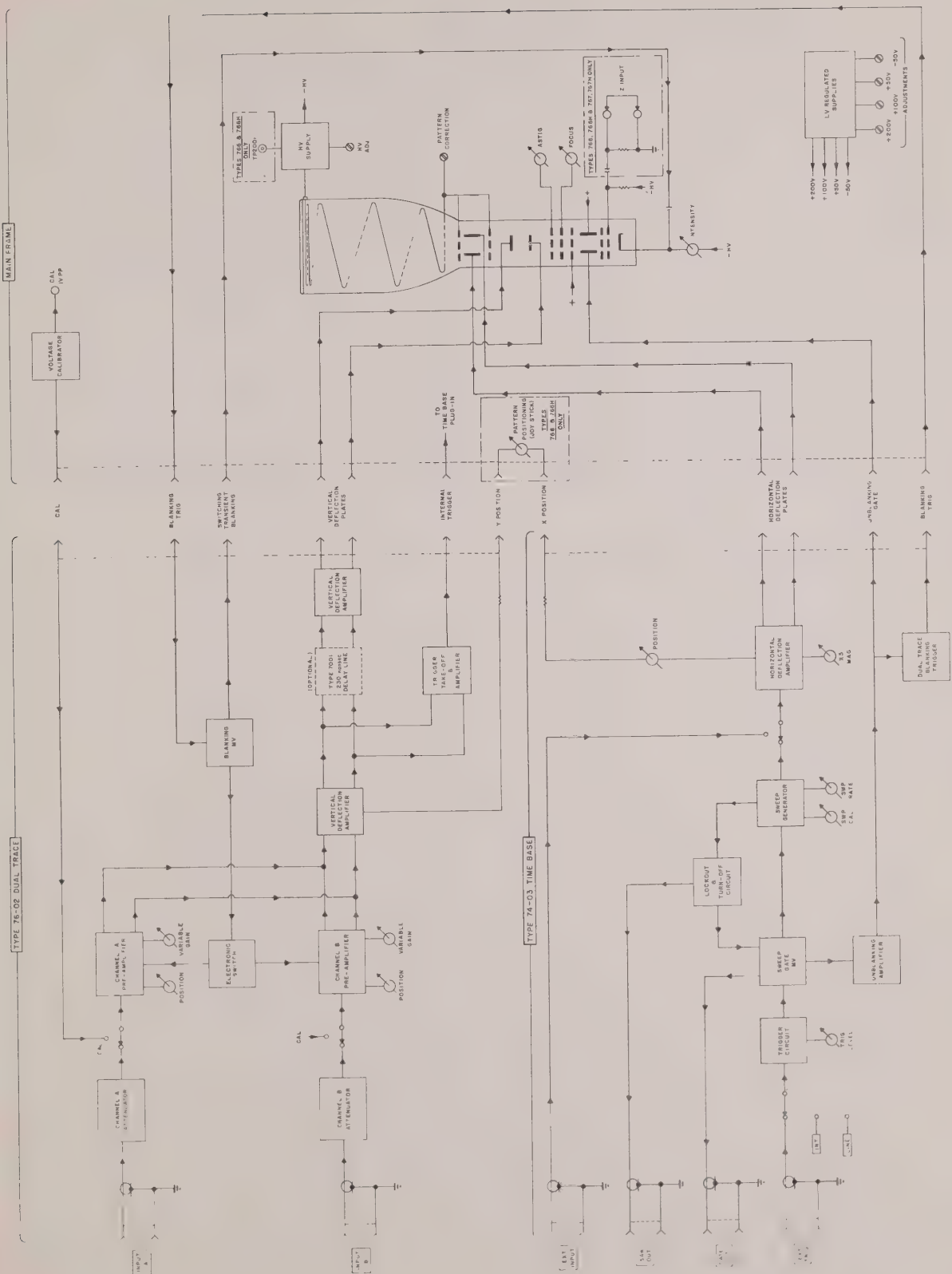


FIGURE 2-1. OVER-ALL BLOCK DIAGRAM

of the regulated supplies at the Test Points, TP1001 through TP1004, for the low voltages, and at TP2001 for the high voltage. If these voltages are normal, the trouble is in the Time Base Plug-in itself. If one or more of these regulated voltages are not as specified, then check out the plug-in as described in the preceding paragraph.

#### **d. Improper Triggering**

If external and line triggering modes are satisfactory, but the internal triggering mode is not, then the trouble may reside in the trigger take-off circuit of the Y Plug-in amplifier that the operator is using. However, if improper triggering cannot be obtained from any of the triggering sources, the trouble probably resides in the Time Base Plug-in itself. Refer to the Time Base Plug-in Instruction Manual for more information.

#### **e. Waveform Distortion**

If the display under observation is distorted, but there is no other manifestation of trouble such as insufficient deflection, improper sweep rate etc., then the problem is confined to the plug-in which is amplifying the distorted signal.

## **2-9. PREVENTIVE MAINTENANCE**

This unit is a stable instrument that will provide many hours of trouble-free operation. However, to insure the reliability of measurements, we suggest that you recalibrate the instruments after each 500 hours of operation or every six months if used intermittently. Also, the calibration of a unit should always be checked and adjusted as necessary after the repair or replacement of any component in the unit. The complete adjustment procedure for the Main Frame is given in Section 3 of this Instruction Manual. The internal calibrator or a more precise standard may be employed to set the front-panel screwdriver GAIN ADJ or SWP CAL controls on the plug-ins. Refer to the appropriate plug-in Instruction Manual for calibration procedures for these modules.

The proper procedure for testing and calibrating this instrument is with both plug-ins inserted. When performing a complete calibration, the Main Frame should be checked first, then the Y Plug-ins, and finally the Time Base Plug-in. Either or both of the plug-in units can be calibrated separately, however, the regulated power supplies in the Main Frame should always be checked before calibrating any part of the instrument.

## SECTION 3

# MAINTENANCE AND RECALIBRATION

### 3-1. INTRODUCTION

This section of the Instruction Manual contains the circuit description, trouble-shooting instructions, and calibrating procedures for the Main Frame or Indicator Unit alone.

### 3-2. CIRCUIT DESCRIPTION FOR LOW-VOLTAGE REGULATED SUPPLIES (Figure 3-1)

#### a. Power Transformer

Plate and heater power for this instrument is provided by a single power transformer, T1001. The primary is wound with two equal 115-volt windings that can be switched either in parallel for 115-volt operation, or in series for 230-volt operation via the 115V/230V Selector switch, S101. The secondary contains four separate windings which provide power to the regulated supplies and two separate heater windings.

#### b. Regulated Supplies

Four regulated and three unregulated supplies are provided with output as shown in Figure 3-1, Functional Block Diagram of the Power Supply. All of the regulated supplies are of the constant-output voltage series-passing type. The basic reference for all of the regulated supplies is the fixed drop across V101. This gas diode, V101, maintains a constant voltage drop of about 85 volts across itself within a broad current range.

This constant drop or reference voltage source is applied across a divider consisting of R1039, R1041, and R1042. A portion of this fixed voltage is tapped by the -50V ADJ potentiometer, R1041, and is applied to the base of Q114 which subsequently establishes the reference level for the -50V regulated supply. Potentiometer, R1041 is adjusted so that the output is precisely -50 volts. The minus 50-volt output is also the voltage reference source for the other low-voltage regulated supplies. Thus, voltage adjustments are always made in the sequence starting with the -50-volt supply and ending with the +200-volt supply.

Since the operation of the low-voltage regulated supplies are identical, only the +50-volt supply is described. CR1005 and CR1006 are connected in a conventional full-wave rectifier circuit. The rectified output is capacitively filtered by C1012 and C1013 and shunted by resistor R1027 and applied to the voltage regulator.

Operation of the regulator is as follows: assume the output voltage tends to decrease. This will lower the base voltage of the error detector dc amplifier, Q112,

and raise the base voltage of emitter follower, Q111. The increase in voltage at the emitter of Q111 is applied to the base of the series-passing transistor, Q113. The resultant increase in voltage at the emitter of Q113 is such as to return the output voltage to its proper value.

A fail-safe circuit has been provided for the series-passing transistors to protect them against transient overload. In the event there is a short circuit, zener diode CR1013 comes into play to preserve the transistors. This diode will start to conduct before the breakdown voltage of series-passing transistor, Q113, is exceeded, and shunt the excess current around the transistor. F104 protects the zener diode from damage due to excessive currents.

#### c. Voltage Calibrator

The power-line frequency voltage from T1001 is applied to the base of the voltage calibrator, Q118, through limiting resistor, R1051. Negative and positive voltage excursions will drive the transistor into and out of conduction at the line-frequency rate. The resulting square wave is applied to a voltage divider consisting of R1052, R1053, and R1054. The attenuated calibrator output of one volt peak-to-peak is coupled to the amplifier plug-in when the VOLTS/DIV switch is set to CAL. The plus 100-volt supply and the saturation voltage of the transistor will determine the peak-to-peak voltage excursion of the calibrator waveform.

### 3-3. CRT CIRCUIT

#### a. CRT Beam Control Circuits

The INTENSITY control, R2016, part of the negative high-voltage divider, is used to vary the cathode-ray tube grid voltage to adjust the beam current. The FOCUS control, R2014, varies the voltage at the focusing anode to set the second cross-over point right at the screen of the cathode-ray tube. The ASTIGMATISM control, R2022, is provided to vary the voltage at the astigmatism anode to focus the spot in both axes simultaneously. The PATTERN CORREction service adjustment, R2021, is set to vary the field the cathode-ray beam encounters as it emerges from the deflection system to control the linearity at the extremes of deflection.

#### b. High-Voltage Power Supply

Accelerating voltages for the cathode-ray tube are obtained by rectifying a 60 Kc high voltage produced by a vacuum-tube oscillator. V202 is the oscillator tube connected as a Hartley oscillator with the primary of

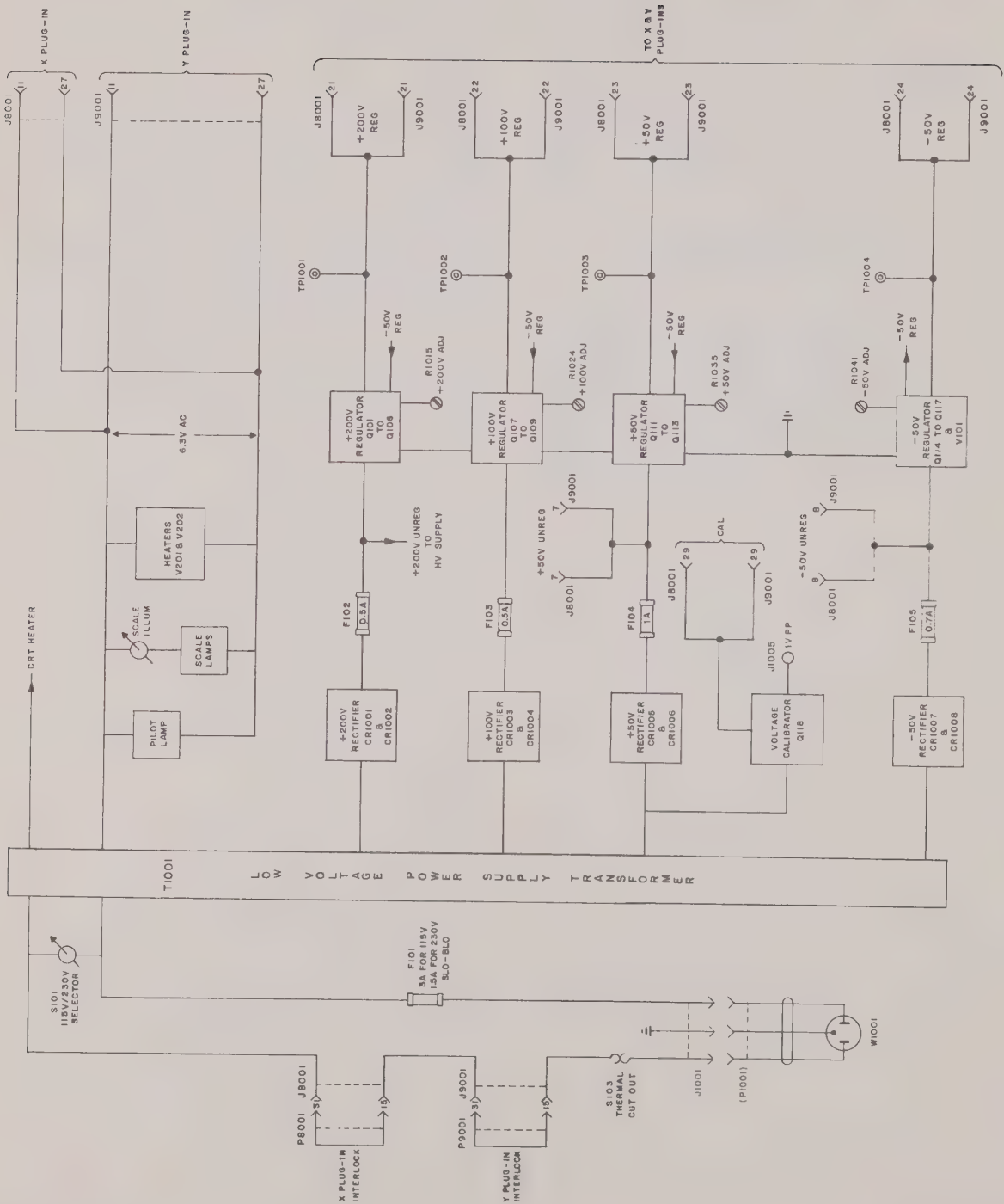


FIGURE 3-1. MAIN FRAME LV POWER SUPPLY FUNCTIONAL BLOCK DIAGRAM

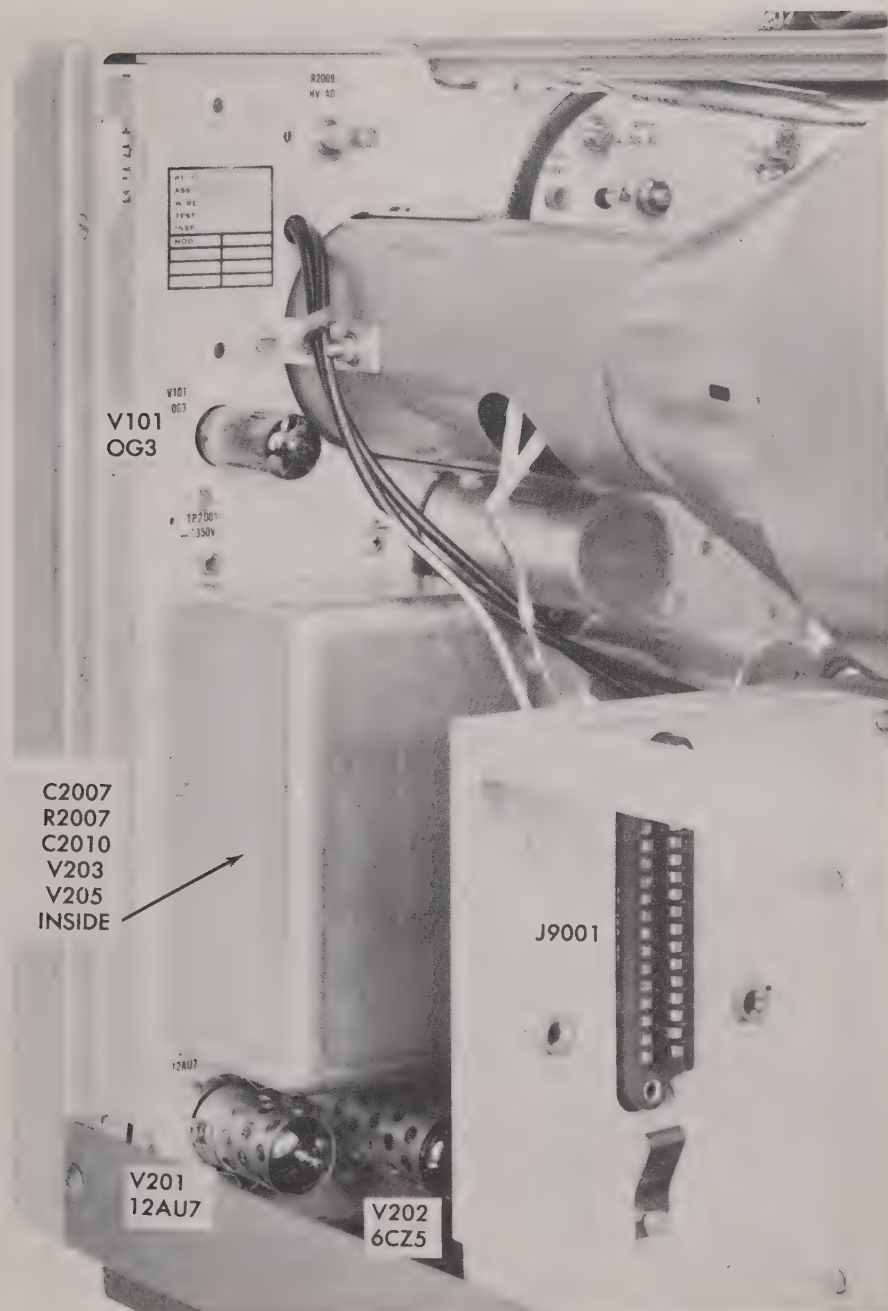


FIGURE 3-2. IDENTIFICATION OF REPLACEABLE PARTS (LEFT SIDE VIEW)

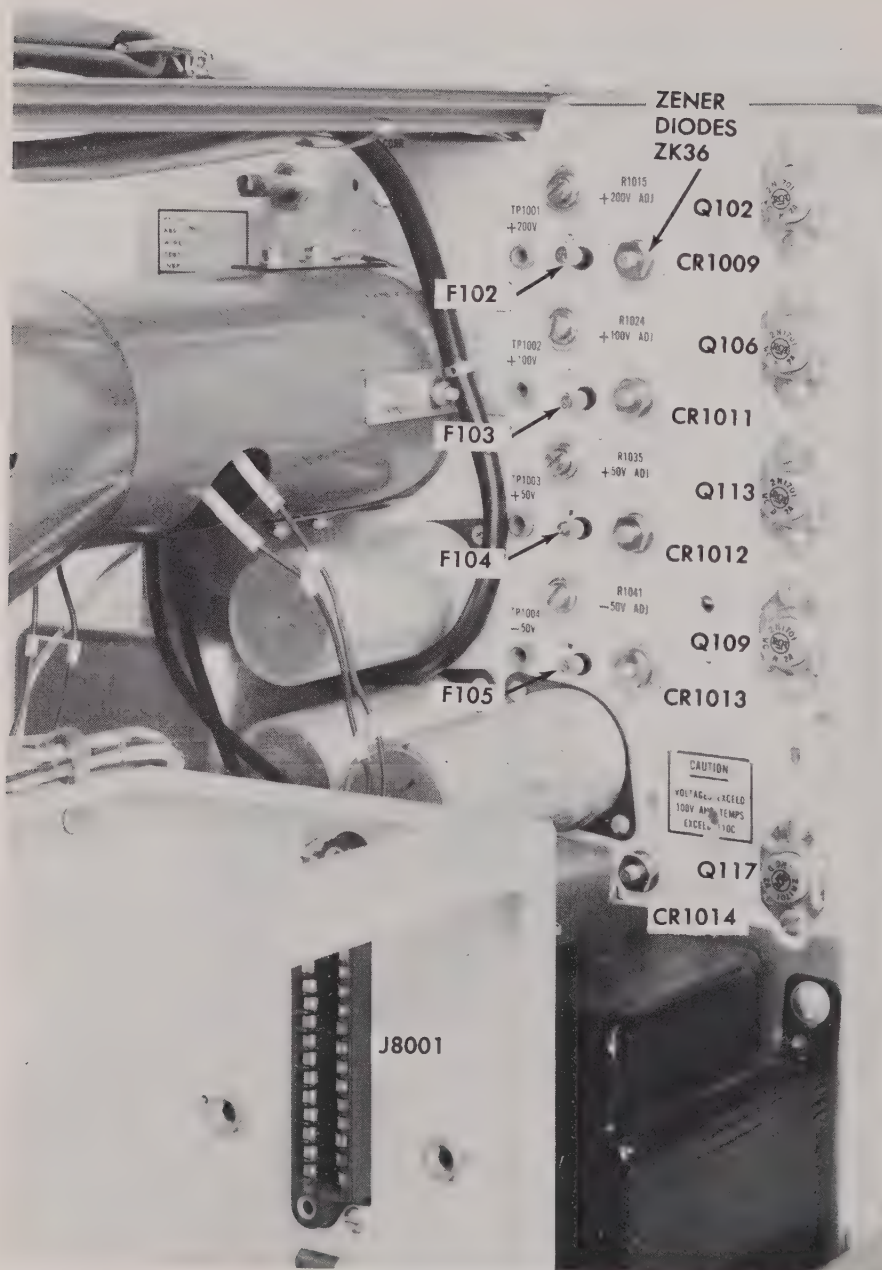


FIGURE 3-3. IDENTIFICATION OF REPLACEABLE PARTS (RIGHT SIDE VIEW)

transformer, T2001, as the tapped inductor, and C2006 as the capacitor.

The output of the oscillator is stepped up by T2001 and applied to a conventional rectifier and subsequently applied to the post-deflection accelerator of the cathode-ray tube.

The negative high-voltage supply is derived from a tap on transformer T2001 which is connected to a half-wave rectifier, CR2001. The rectified output of —1350 volts to —1440 volts is capacitively filtered by C2008, C2009, and C2011 and provides the necessary operating potentials for the proper intensity and focusing of the cathode-ray tube.

Regulation of the high-voltage negative supply is accomplished by sampling a portion of the rectified output and applying a correction signal back through V201 to the screen grid of V202. This action changes the amplitude of oscillations of V202 and T2001 in such a manner as to restore the high voltage output to its preset level. Potentiometer R2009, HV ADJ, is provided to preset the output of the high-voltage supply to its proper level.

### 3-4. CIRCUIT TROUBLE SHOOTING

General maintenance and trouble shooting information will be found in Section 2 of this Instruction Manual. In the following discussion it is assumed that the operator has read that information and has definitely isolated a trouble to the Indicator Unit by the procedures described there.

The first step in trouble shooting the Indicator Unit is to measure the power-supply voltages at Test Points TP1001 through TP1004 located on the Main Frame. If all of the voltages are not as indicated, the trouble is in the low-voltage power supply or the power source. To check these, refer to the paragraph entitled "Trouble Shooting the Power Supply." If all these voltages are proper, the trouble resides in the cathode-ray tube circuit. In this instance, refer to the paragraph entitled "Trouble Shooting the Cathode-Ray Tube Circuit."

### 3-5. LOCATION OF REPLACEABLE COMPONENTS

Identifications of all replaceable components, including those mounted on assembly boards are shown in Figures 3-2 through 3-5.

Since the production of this instrument, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from Du Mont, and it has been superseded by an improved component, the new part will be shipped in place of the part ordered. Your local Du Mont representative has knowledge of these changes and may call you if a change in your purchase order is necessary.

It is the aim of the Du Mont organization to make available the most reliable commercial oscilloscopes within the state of the art and to provide services

which will help the user to rapidly restore any Du Mont equipment to its specified performance. Your local Du Mont field representative maintains a limited number of spare parts or the factory may be asked to air-ship replacement parts.

### 3-6. TROUBLE SHOOTING THE POWER SUPPLY

#### WARNING

WHEN THE PANELS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON. The lower-voltage busses are potentially more dangerous than the cathode-ray tube potential because of the high-current capabilities and large filter capacitors employed in these supplies. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

As an aid in trouble-shooting the power supply, refer to the functional block diagram, Figure 3-2 and to the low-voltage power supply schematic.

1. If the instrument fails to operate, including the pilot light, check the source of power and determine that the power cord is firmly in place. Then check the fuse at the rear of the instrument.

**NOTE:** Disconnect the power cord when working on the transformer T1001 and associated circuits.

If the fuse is blown, replace it with one of the proper value and reconnect the line cord. If the new fuse blows, immediately check the power transformer for shorted primary or secondary windings. Shorted rectifiers in the secondary circuit will also blow the line fuse F101. Check for an open primary winding of T1001 if the line fuse is good.

2. A thermal cutout switch is incorporated in this unit. If the instrument has been working but has just stopped, it may have overheated and tripped the thermal cutout switch. The thermal cutout switch will reset itself when the interior temperature of the instrument drops to a safe value. Possible causes of overheating are: restriction of air circulation and high ambient temperature.

3. If the line voltage is within the specified limits, and one of the regulated power-supply output voltages is not correct, check that particular regulator circuit. Each of the regulated supplies is fused separately. These fuses should be checked and replaced if necessary with a new fuse of the proper value.

**NOTE:** Always check the regulated voltages starting with the —50-volt supply and ending with the +200-volt supply.

When the circuit ailment has been confined to a particular regulator, then one may trouble-shoot within this circuit to locate the defective component(s). The description of the circuit involved may prove useful when diagnosing circuit ailments.

4. If none of the regulated voltages are correct, then the trouble probably resides in the -50-volt regulated supply since this voltage serves as a reference level for the other three regulated circuits.

One cause of insufficient output voltage is low unregulated dc voltage which might be caused by an open or shorted rectifier diode. These diodes are identified on Figure 3-5 and are:

- CR1007 & CR1008 for the -50V regulated supply
- CR1005 & CR1006 for the +50V regulated supply
- CR1003 & CR1004 for the +100V regulated supply
- CR1001 & CR1002 for the +200V regulated supply

5. If there is excessive ripple on any of the unregulated supplies, replace the filter capacitor(s). These capacitors are identified on Figure 3-5 and are:

- C1018 for the -50V regulated supply
- C1012 & C1013 for the +50V regulated supply
- C1006 for the +100V regulated supply
- C1001 for the +200V regulated supply

### 3-7. TROUBLE SHOOTING THE CRT CIRCUIT

The intensity, focus, geometry, and calibration of the cathode-ray tube display depend on proper operation of the high-voltage supply. To isolate this trouble, remove the rear cover from the Main Frame and high voltage cover, and observe if the filaments of the high-voltage rectifiers are glowing. If they are, measure the voltage at Test Point, TP2001. This voltage reading should be between -1350 and -1440 volts with respect to ground. Also, measure the voltages at other points in the circuit for which typical values are given on the high-voltage power supply schematic. If all of these voltages check out correctly, then the trouble may reside with the cathode-ray tube itself which should be checked.

If the filaments of the high-voltage rectifiers are not glowing, then measure the voltage at the grid of the high-voltage oscillator, V202. It should measure about -25 volts, and if it does, the high-voltage oscillator is working and the trouble may reside with the high-voltage rectifiers or the secondary winding of T2001.

However, if the voltage at the grid of the high-voltage oscillator, V202, is significantly less than -25 volts, then this stage is not operating properly. There are certain checks that should be made before replacing V202 to prevent possible damage to the replacement tube. First, measure the plate voltage of V202; it should measure about +218 volts. If the plate voltage of V202 checks out OK, then measure the resistance of the primary and secondary windings of T2001.

The resistance across the primary winding should measure around 5 ohms. Measure the resistance of the secondary winding from the plate of V203 to ground; it should measure around 175 ohms. If the resistance

and voltage checks are correct, then replace V201 and V202.

If the low-voltage power supply is operating normally, but no spot or trace is visible on the screen, then the trouble might be a defective cathode-ray tube, a defect in the CRT circuitry including the high-voltage supply, an unbalanced condition in either of the plug-in modules, or a defective unblanking circuit.

**NOTE:** To obtain a spot or trace on the screen, the cathode-ray tube must be unblanked.

Refer to the appropriate plug-in module Instruction Manual for further information.

## 3-8. TEST EQUIPMENT REQUIRED FOR SERVICE ADJUSTMENTS

### a. Introduction

The adjustments outlined in the following paragraphs are based on the test procedure followed at the factory. All adjustments should be made at mid-line voltage, 115/230V  $\pm 2\%$ . To set up the Indicator Unit for calibration, insert an amplifier plug-in and a time base plug-in into the main frame. These plug-in modules are signal sources for the Main Frame and must be fully tested and certified units. No testing will be performed on the plug-ins for calibration of the Indicator.

### b. Test Equipment Required (Equivalent may be substituted)

| Type                          | Description                                                                                  |
|-------------------------------|----------------------------------------------------------------------------------------------|
| Volt-ohmmeter                 | Simpson Model 260 with polarity-reversing switch and tip leads; 20,000 ohms/volt sensitivity |
| Oscilloscope                  | Du Mont Type 403B with anti-parallax scale (scale #4501 0131)                                |
| Attenuator Probe              | Du Mont Type 4290; 10:1 and terminated in BNC type connector; 10 megohms, 10 pf input        |
| High-voltage Meter            | Sensitive Research Model DCH-1                                                               |
| Autotransformer               | Du Mont Type 2165 Line Control Unit; Powerstate, Variac, etc.                                |
| Digital Voltmeter             | John Fluke Model 801B; 0.1 to 500 volts                                                      |
| AC Voltmeter                  | Weston Model 433                                                                             |
| Standard Amplitude Calibrator | Ballantine Type 420                                                                          |
| LC Meter                      | Tektronix Type 130                                                                           |

## 3-9. ADJUSTING THE LOW-VOLTAGE POWER SUPPLIES

Connect the autotransformer to a suitable power source and connect the oscilloscope to the output of this transformer. Turn on the instrument and set the output for the nominal operating voltage of the oscil-

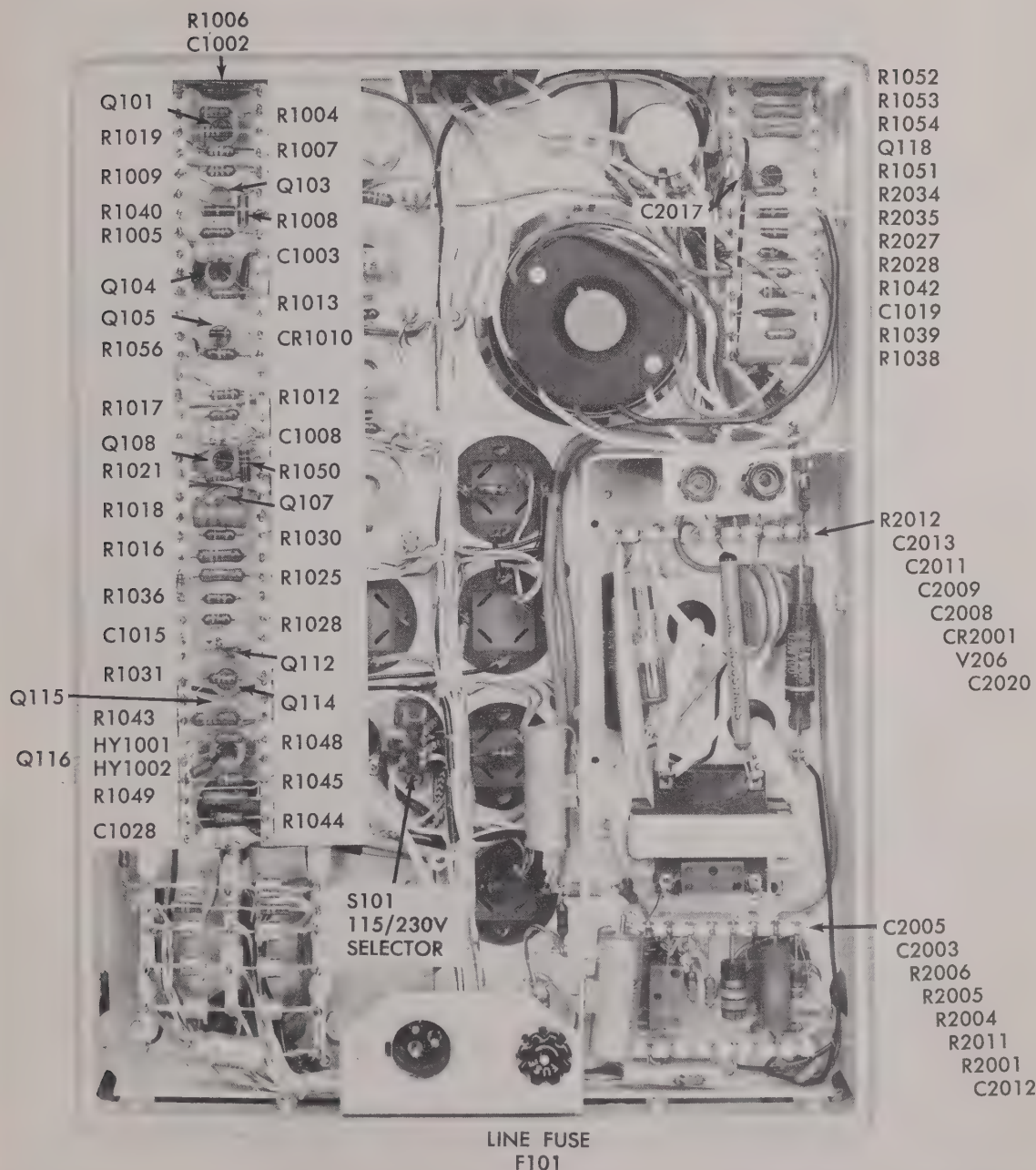


FIGURE 3-4. IDENTIFICATION OF REPLACEABLE COMPONENTS ON REAR CHASSIS



loscope (115V for 115-volt operation or 230V for 230-volt operation). Allow the instrument to warm up for about 10 minutes.

**NOTE:** Do not adjust the —50-volt supply unless one or more of the supplies is actually out of tolerance or unless a complete calibration of the instrument is desired.

Use a John Fluke Voltmeter and adjust or check the supplies in the sequence and at the Test Points listed.

| Regulated Supply | Tolerance   | Test Point | Service Adjustment |
|------------------|-------------|------------|--------------------|
| —50V             | $\pm 10$ mv | TP1004     | R1041 —50V ADJ     |
| +50V             | $\pm 20$ mv | TP1003     | R1035 +50V ADJ     |
| +100V            | $\pm 20$ mv | TP1002     | R1024 +100V ADJ    |
| +200V            | $\pm 30$ mv | TP1001     | R1015 +200V ADJ    |

Vary the autotransformer output voltage between 105 and 125 volts and check to see that all regulated supplies stay within  $\pm 1\%$  except the +200-volt supply which is  $\pm 1.5\%$ . For 230-volt operation, vary the autotransformer output between 210 and 250 volts and check to see that all voltages stay within the above tolerance.

### 3-10. HIGH-VOLTAGE ADJUSTMENT

Use Sensitive Research High-Voltage Meter and Probe with caution.

1. Adjust R2009 (HV ADJ) for  $-1350V \pm 15$  volts.

### 3-11. CRT ADJUSTMENT

#### a. Graticule External to CRT

To align the trace to the graticule, proceed as follows:

1. Use recurrent sweep with no signal applied to vertical channel.
2. Center trace and rotate CRT to match scale.
3. Tighten CRT clamp.

To align the graticule to the scan, proceed as follows:

1. Apply line-frequency hum to Y INPUT and adjust oscilloscope for full-screen deflection.
2. Slow sweep rate to 50 ms/cm. Note full raster display on screen.
3. Adjust eccentric cam to assure full 6-centimeter coverage of scale and vertical CRT scan.

#### b. Graticule Internal to CRT

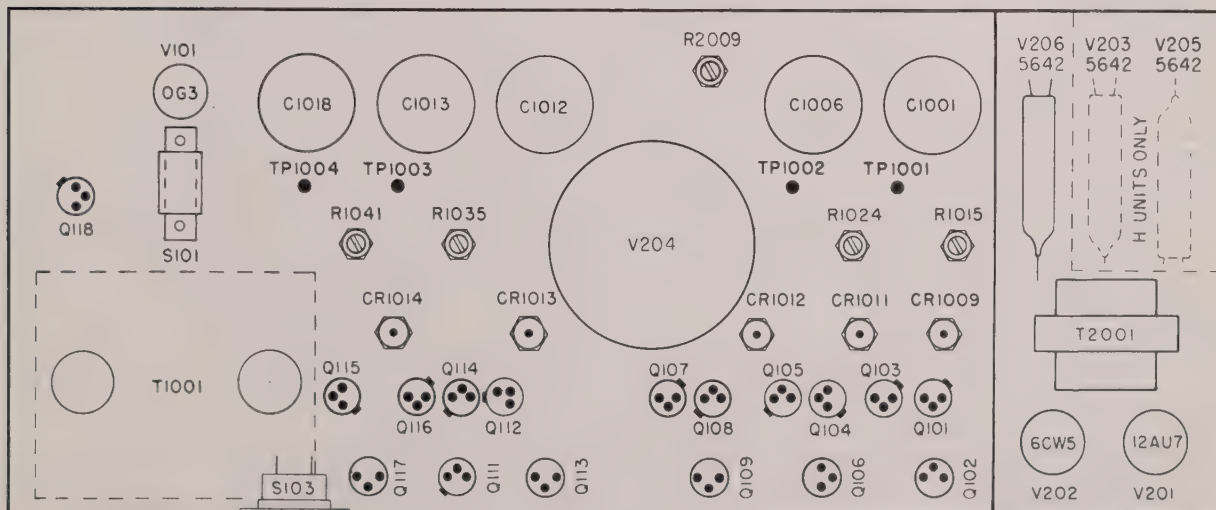
1. Where the graticule is internal to the CRT, align the tube so that the horizontal center line is perpendicular to the left side of the frame, using a suitable fixture. Clamp CRT.

2. Use recurrent sweep with no signal applied to the vertical channel.

3. Center trace and adjust R2022R until trace is parallel to horizontal lines of scale.

#### c. Pattern Correction ADJ

1. Set Y VOLTS/DIV switch to CAL and SWEEP



RATE switch to 5 MS/CM. Note steady square wave pattern on screen.

2. Set PATTERN CORRECTION control, R2021, until the vertical and horizontal lines at the 6 x 10 cm edges are optimally straight.

NOTE: The display should fall within a 6 x 10 cm and a 5.75 x 9.75 cm rectangular frame.

### 3-12. SETTING MAIN FRAME CAPACITY (C1031 & C1032)

#### a. Regular Method

If fully tested and certified Plug-in modules are not available, then proceed as follows:

1. Obtain a capacity meter with a "Guard Voltage" (which eliminates the effects of other capacitances from the measurements) similar to Tektronix Type 130 LC Meter, or equivalent.

2. Remove the Y-Plug-in module.

3. Connect the "Guard Voltage" of the LC Meter to J9001-1 and measure the capacity to ground of J9001-17. Note this measurement as "A".

4. Connect the "Guard Voltage" of the LC Meter to J9001-17 and measure the capacity to ground of J9001-1. Note this measurement as "B".

5. Remove the Guard Voltage from J9001-17 and ground J9001-17.

6. Measure the capacity from J9001-1 to ground. Note this measurement as "C".

$$A + B$$

7. Then  $\frac{A + B}{2} + 2(C - B) = 6.3 \text{ pf}$  for the Y side.

If not, adjust C1031 until this condition is obtained.

8. Reinstall the Y Plug-in module and remove the X Plug-in module.

9. Repeat steps 3 through 6 using J8001-1 and J8001-17.

10. The relationship of the parameters in step 7 should equal 7.8 pf for the X side; if they do not, adjust C1032 until this condition is obtained.

#### b. Alternate Method

If fully tested and certified X and Y Plug-in modules are available, then the Main Frame trimmers may be adjusted as follows:

1. Install the X and Y Plug-in modules in their respective cavities.

2. Apply a fast-rise pulse from a Tektronix Type 107 Square Wave Generator or equivalent to Y INPUT and set VOLTS/DIV switch to 5.

3. Adjust Pulse Generator for 5 centimeters of vertical deflection.

4. Adjust C1031 for overshoot of 2 mm or less.

5. Interchange the X and Y Plug-in modules (X inserted into Y side and vice versa).

6. The fast-rise signal is again applied to Y INPUT (which is now in the X cavity).

7. Adjust the oscilloscope for 2 centimeters of deflection.

8. Adjust C1032 for optimum pulse response.

## SECTION 4

### PERFORMANCE ASSURANCE TEST

#### 4-1. MAINTENANCE CHECK TO ASSURE PERFORMANCE

The test described in the paragraphs to follow should be performed by Instrument Test Departments and Maintenance Laboratories to certify proper performance of this instrument. These tests are divided into sections for simplification and to assist those test groups where complete checking is not mandatory, or where all test equipment is not available. Refer to Section 3, paragraph 3-8 for list of test equipment required.

##### NOTE

If this oscilloscope is checked by a receiving inspection laboratory, the tests outlined below are recommended to certify performance. This oscilloscope has been thoroughly tested and aged at the factory. Nevertheless, rough shipment, extreme environments, or long idle periods may necessitate minor adjustments of the controls. Hence it is suggested that the certifying engineer try the recommended adjustments not only for recentering the controls, but also to ascertain their range and to familiarize himself with this precision instrument. If, after performing all the tests outlined below, the instrument will not perform to specification, the assistance of the local Du Mont Field Engineering representative should be requested.

#### 4-2. CHECKING THE POWER SUPPLY

1. Check the line fuse, F101, for proper value: 3 amperes for 115-volt operation; 1.5 amperes for 230-volt operation.
2. Check fuses of the regulated supplies for proper value:

| Regulated Supply | Symbol | Fuse Rating |
|------------------|--------|-------------|
| -50 volts        | F105   | 0.7 ampere  |
| +50 volts        | F104   | 1 ampere    |
| +100 volts       | F103   | 0.5 ampere  |
| +200 volts       | F102   | 0.5 ampere  |

3. Examine the instrument for charred or mechanically damaged components. Correct all defects.
4. Apply power to the instrument through a variable voltage source (Variac, or an equivalent). Set the line voltage to 115 volts. (Double this value for 230-volt operation.)

5. Set up the oscilloscope to obtain six cycles of the calibrator signal.

6. Allow 20 minutes for warmup before making any adjustments.

7. Lower the line voltage until the display starts to drift, or becomes erratic. The line voltage must be less than 105 volts at 60 cycles (210 volts for 230-volt operation). If instability is noted before the lower limit of the line voltage is reached, check operation of the low-voltage regulated power supplies as outlined in Section 3 of this Instruction Manual.

**NOTE:** Always check the regulated voltages starting with the -50-volt supply and ending with the +200-volt supply.

8. Raise the line voltage to 125 volts (250 volts for 230-volt operation). The display should remain stable and must not be erratic. If instability is noted before the upper limit of the line voltage is reached, check operation of the low-voltage power supplies.

9. Reset the line voltage to 115 volts (230 volts for 230-volt operation).

#### 4-3. CHECK RIPPLE OF LOW-VOLTAGE SUPPLIES

1. Use a Type 403B Test Oscilloscope with a Type 4290 Probe.
2. Ground all chassis to power-line ground.
3. Set the oscilloscope for ac coupled input and set Y sensitivity to 0.5 mv/cm.
4. Use AUTO triggering with line sync and set SWEEP RATE switch to 5 MS/CM.
5. Measure the amount of 120-cycle ripple at the output of each power supply as listed below. (For line frequencies other than 60 cycles, the ripple will be twice the line frequency.)

| Regulated Supply | Ripple Voltage        | Test Point |
|------------------|-----------------------|------------|
| -50 volts        | 10 millivolts p-p max | TP 1004    |
| +50 volts        | 20 millivolts p-p max | TP1003     |
| +100 volts       | 30 millivolts p-p max | TP1002     |
| +200 volts       | 65 millivolts p-p max | TP1001     |

#### 4-4. CALIBRATOR CHECK

##### a. Waveshape Check

1. Adjust the Type 403B Oscilloscope for a sensitivity of 20 mv/cm and connect the Y INPUT to the CAL pin jack on the front panel of the Main Frame via the Type 4290 Attenuator Probe.
2. Observe a 1 volt (5 cm) peak-to-peak, 60-cycle square wave; rise time to be less than 20  $\mu$ sec. Tilt and ringing should be less than 5% (50 mv or 2.5 mm).

### **b. Amplitude Accuracy (Optional Test)**

**NOTE:** This check is not required on every oscilloscope.

1. Precisely calibrate the Type 403B Oscilloscope with the Ballantine Type 420 Calibrator. The oscilloscope is set up with the Type 4290 Probe at a sensitivity of 20 mv/cm.

2. Set the Ballantine Calibrator for a frequency of 1 Kc at an output of 1 volt peak.

3. Adjust oscilloscope for a 5-centimeter vertical bar.

4. Transfer the Probe from the Ballantine Calibrator to the 1-volt pin jack. Note Calibrator amplitude to be 4.9 to 5.1 cm (1 volt  $\pm 2\%$ ). Avoid errors by using the anti-parallax scale.

## **4-5. CHECKING CRT GEOMETRY ADJUSTMENT**

Set Y VOLTS/DIV switch to CAL and SWEEP RATE switch to 5 MS/CM. Note the steady square wave pattern on the screen. The display should fall within a 6 x 10 centimeter and a 5.75 x 9.75 centimeter frame. Refer to the paragraph entitled "CRT Adjustments," in Section 3 of this Instruction Manual for further details.

### **4-6. CRT ADJUSTMENT**

#### **a. Graticule External to CRT**

To align the trace to the graticule, proceed as follows:

1. Use recurrent sweep with no signal applied to vertical channel.

2. Center trace and rotate CRT to match scale.

3. Tighten CRT clamp.

To align the graticule to the scan, proceed as follows:

1. Apply line-frequency hum to Y INPUT and adjust oscilloscope for full-screen deflection.

2. Slow sweep rate to 50 ms/cm. Note full raster display on screen.

3. Adjust eccentric cam to assure full 6-centimeter coverage of scale and vertical CRT scan.

#### **b. Graticule Internal to CRT**

1. Where the graticule is internal to the CRT, align the tube so that the horizontal center line is perpendicular to the left side of the frame, using a suitable fixture. Clamp CRT.

2. Use recurrent sweep with no signal applied to the vertical channel.

3. Center trace and adjust R2022R until trace is parallel to horizontal lines of scale.

#### **c. Pattern Correction ADJ**

1. Set Y VOLTS/DIV switch to CAL and SWEEP RATE switch to 5 MS/CM. Note steady square wave pattern on screen.

2. Set PATTERN CORRECTION control, R2021, until the vertical and horizontal lines at the 6 x 10 cm edges are optimally straight.

**NOTE:** The display should fall within a 6 x 10 cm and a 5.75 x 9.75 cm rectangular frame.

# SECTION 5

## ELECTRICAL PARTS LIST AND SCHEMATICS

### FOR TYPE 765- FAMILY OF OSCILLOSCOPES

#### NOTE

The following Parts List is common to the Types 765/765M/765H/765MH/766/766H/767/767H.

Parts peculiar to a particular instrument are listed separately at the end of the Parts List. These parts are indicated by an \* in the main Parts List.

| Symbol                                                                                                   | Part Number | Description                                | Recommended Vendor Code | Type          | Symbol                | Part Number | Description                                             | Recommended Vendor Code | Type                       |
|----------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------|-------------------------|---------------|-----------------------|-------------|---------------------------------------------------------|-------------------------|----------------------------|
| <b>CAPACITORS</b>                                                                                        |             |                                            |                         |               |                       |             |                                                         |                         |                            |
| Notes: 1. All capacitors are fixed, ceramic, and 150V unless otherwise specified; pf denotes picofarads. |             |                                            |                         |               |                       |             |                                                         |                         |                            |
| 2. GMV denotes Guaranteed Minimum Value.                                                                 |             |                                            |                         |               |                       |             |                                                         |                         |                            |
| C1000                                                                                                    | 0319 106C   | 0.01 $\mu$ f, +60 —40%                     | CRL                     | DDM           | C2003                 | 0316 8790   | mica, 510 pf, $\pm$ 20%, 1000V                          | EMC                     | VCM-20-B                   |
| C1001                                                                                                    | 0319 3880   | electrolytic, 300 $\mu$ f, +100 —10%, 250V | MAL                     | FP            | C2004                 | 0318 4670   | electrolytic, 12 $\mu$ f, +250 —10%, 250V               | CDE                     | BBR-                       |
| C1002                                                                                                    | 0319 1060   | 0.01 $\mu$ f, +60 —40%                     | CRL                     | DDM           | C2005                 | 0316 8790   | mica, 510 pf, $\pm$ 20%, 1000V                          | EMC                     | VCM-20-B                   |
| C1003                                                                                                    | 0326 7840   | plastic, 0.047 $\mu$ f, $\pm$ 10%, 125V    | AMX                     | C296AA        | *C2007                |             |                                                         |                         |                            |
| C1004                                                                                                    | 0327 1890   | electrolytic, 25 $\mu$ f, +100 —10%        | MAL                     | TCW           | C2008                 | 0316 4930   | 0.01 $\mu$ f, +100 —0%, 2000V                           | RMC                     | 2 KV                       |
| C1005                                                                                                    | 0319 1050   | 0.02 $\mu$ f, +60 —40%                     | CRL                     | DDM           | & C2009               |             |                                                         |                         |                            |
| C1006                                                                                                    | 0319 3890   | electrolytic, 400 $\mu$ f, +150 —10%       | MAL                     | FP            | *C2010                |             |                                                         |                         |                            |
| C1007                                                                                                    | 0326 4660   | 0.02 $\mu$ f, GMV, 500V                    | ERC                     |               | C2011                 | 0316 4930   | 0.01 $\mu$ f, +100 —0%, 2000V                           | RMC                     | 2 KV                       |
| C1008                                                                                                    | 0326 7840   | plastic, 0.047 $\mu$ f, $\pm$ 10%, 125V    | AMX                     | C296AA        | C2012                 | 0326 6320   | 0.01 $\mu$ f, $\pm$ 10%, 200V                           | GUD                     | No. 355C                   |
| C1009                                                                                                    | 0327 1890   | electrolytic, 25 $\mu$ f, +100 —10%        | MAL                     | TCW           | C2013                 | 0326 9350   | paper, 1000 pf, $\pm$ 10%, 1600V                        | SPG                     | 73P "Black Beauty"         |
| C1010                                                                                                    | 0326 7860   | plastic, 0.1 $\mu$ f, $\pm$ 10% 125V       | AMX                     | C296AA        | C2014                 | 0316 4930   | 0.01 $\mu$ f, +100 —0%, 2000V                           | RMC                     | 2 KV                       |
| C1011                                                                                                    | 0319 1050   | 0.02 $\mu$ f, +60 —40%                     | CRL                     | DDM           | C2015                 | 0327 1740   | 0.0496 $\mu$ f, +80 —20%, 200V                          | ERC                     | Weecon Ceramics, Style4865 |
| C1012                                                                                                    | 0319 3890   | electrolytic, 400 $\mu$ f, +150 —10%       | MAL                     | FP            | C2016                 | 0316 4930   | 0.01 $\mu$ f, +100 —0%, 2000V                           | RMC                     | 2 KV                       |
| & C1013                                                                                                  | 0319 1060   | 0.01 $\mu$ f, +60 —40%                     | CRL                     | DDM           | *C2017                |             |                                                         |                         |                            |
| C1014                                                                                                    | 0326 7840   | plastic, 0.047 $\mu$ f, $\pm$ 10%, 125V    | AMX                     | C296AA        | C2018                 |             |                                                         |                         |                            |
| C1016                                                                                                    | 0326 4660   | 0.02 $\mu$ f, GMV, 500V                    | ERC                     |               | & C2019               | 0326 4620   | 5000 pf, GMV, 500V                                      | ERC                     |                            |
| C1017                                                                                                    | 0319 1050   | 0.02 $\mu$ f, +60 —40%                     | CRL                     | DDM           | *C2020                |             |                                                         |                         |                            |
| C1018                                                                                                    | 0319 3890   | electrolytic, 400 $\mu$ f, +150 —10%       | MAL                     | FP            | C2021                 | 0318 3710   | plastic, 0.1 $\mu$ f, $\pm$ 20% 400V                    | GUD                     | No. 338E                   |
| C1019                                                                                                    | 0326 4640   | 0.01 $\mu$ f, GMV, 500V                    | ERC                     |               | C2022                 | 0326 4640   | 0.01 $\mu$ f, GMV, 500V                                 | ERC                     |                            |
| C1020                                                                                                    | 0326 7840   | plastic, 0.047 $\mu$ f, $\pm$ 10%, 125V    | AMX                     | C296AA        | <b>SEMICONDUCTORS</b> |             |                                                         |                         |                            |
| C1021                                                                                                    | 0326 7840   | plastic, 0.047 $\mu$ f, $\pm$ 10%, 125V    | AMX                     | C296AA Series | CR1001                |             |                                                         |                         |                            |
| C1022                                                                                                    | 0326 7600   | electrolytic, 100 $\mu$ f, +100 —10%, 12V  | SPG                     | "Littl-Lytic" | & CR1002              | 2600 6670   | diode, silicon, 1N1763                                  | RCA                     |                            |
| C1023                                                                                                    | 0327 1890   | electrolytic, 25 $\mu$ f, +100 —10%        | MAL                     | TCW           | CR1003                |             |                                                         |                         |                            |
| C1024                                                                                                    | 0319 1050   | 0.02 $\mu$ f, +60 —40%                     | CRL                     | DDM           | to CR1008             | 2600 6810   | diode, 1N2861                                           | RCA                     | Part                       |
| C1025                                                                                                    | 0327 1890   | electrolytic, 25 $\mu$ f, +100 —10%        | MAL                     | TCW           | CR1009                | 2600 7560   | diode, ZK36                                             | ITT                     | No. ZK36                   |
| C1026                                                                                                    |             |                                            |                         |               | CR1010                | 2600 6910   | diode, FD841                                            | FCI                     | FD841                      |
| & C1027                                                                                                  | 0326 4620   | 5000 pf, GMV                               | ERC                     |               | CR1011                |             |                                                         |                         |                            |
| C1028                                                                                                    | 0326 7840   | plastic, 0.047 $\mu$ f, $\pm$ 10%, 125V    | AMX                     | C296AA        | to CR1014             | 2600 7560   | diode, ZK36                                             | ITT                     | Part                       |
| C1029                                                                                                    | 0326 8760   | plastic, 0.1 $\mu$ f, $\pm$ 10%, 125V      | AMX                     | C296AA        |                       |             |                                                         |                         | No. ZK36                   |
| C1030                                                                                                    | 0319 1060   | 0.01 $\mu$ f, +60 —40%                     | CRL                     | DDM           | CR2001                | 2600 2711   | rectifier, selenium, metallic                           | ABD                     |                            |
| C1031                                                                                                    |             |                                            |                         |               | <b>LAMPS</b>          |             |                                                         |                         |                            |
| & C1032                                                                                                  | 0319 1251   | variable, 0.4-2.5 pf, 350V                 | ABD                     |               | *DS1001               |             |                                                         |                         |                            |
| C1033                                                                                                    | 0319 1060   | 0.01 $\mu$ f, +60 —40%                     | CRL                     | DDM           | E1001                 |             |                                                         |                         |                            |
| C2002                                                                                                    | 0326 4550   | 2000 pf, GMV, 500V                         | ERC                     |               | & E1002               | 1200 1310   | incandescent, miniature bayonet, .150 ampere, 6.3V, #47 | GE                      | #47                        |
|                                                                                                          |             |                                            |                         |               | <b>FUSES</b>          |             |                                                         |                         |                            |
|                                                                                                          |             |                                            |                         |               | F101                  | 1100 5210*  | 3 amperes, slow-blow, 115-volt operation                | BUS                     | MDX3                       |

| Symbol | Part Number | Description                                | Recommended Vendor Code | Type      | Symbol    | Part Number | Description                                                       | Recommended Vendor Code | Type       |
|--------|-------------|--------------------------------------------|-------------------------|-----------|-----------|-------------|-------------------------------------------------------------------|-------------------------|------------|
| F101   | 1100 5270*  | 1.5 amperes, slow-blow, 230-volt operation | BUS                     | MDX1½     | R1010     | 0234 8690   | 100K                                                              | CGW                     | C-20       |
| F102   |             |                                            |                         |           | R1011     | 0203 1720   | composition, 39, ±10%                                             | ALB                     | EB         |
| & F103 | 1100 7690   | ½ ampere                                   | LFI                     | Cat. #272 | R1012     | 0234 8670   | 82K                                                               | CGW                     | C-20       |
| F104   | 1100 7680   | 1 ampere                                   | LFI                     | Cat. #272 | R1013     | 0234 8480   | 13K                                                               | CGW                     | C-20       |
| F105   | 1100 7670   | 0.7 ampere                                 | LFI                     | Cat. #272 | R1014     | 0235 2480   | 13K, ±2%, 1W                                                      | CGW                     | C-32       |
| *F1201 |             |                                            |                         |           | R1015     | 0109 1770   | variable, wire wound, 4K, ±10% (+200V ADJ)                        | CTS                     | AW         |
|        |             |                                            |                         |           | R1016     | 0235 2540   | 24K, ±2%, 1W                                                      | CGW                     | C-32       |
|        |             |                                            |                         |           | R1017     | 0234 8620   | 51K                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1018     | 0239 1363   | 560. 2W                                                           | ABD                     |            |
|        |             |                                            |                         |           | R1019     | 0234 8100   | 360                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1020     | 0234 8130   | 470                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1021     | 0234 8540   | 24K                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1022     | 0203 1720   | composition, 390, ±10%                                            | ALB                     | EB         |
|        |             |                                            |                         |           | R1023     | 0234 8400   | 6.2K                                                              | CGW                     | C-20       |
|        |             |                                            |                         |           | R1024     | 0109 1770   | variable, wire wound, 4K, ±10% (+100V ADJ)                        | CTS                     | AW         |
|        |             |                                            |                         |           | R1025     | 0235 2490   | 15K, ±2%, 1W                                                      | CGW                     | C-32       |
|        |             |                                            |                         |           | R1026     | 0234 8490   | 15K                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1027     | 0234 8690   | 100K                                                              | CGW                     | C-20       |
|        |             |                                            |                         |           | R1028     | 0234 8540   | 24K                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1029     | 0234 8100   | 360                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1030     | 0234 8030   | 180                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1031     | 0234 8540   | 24K                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1032     | 0203 1720   | composition, 390, ±10%                                            | ALB                     | EB         |
|        |             |                                            |                         |           | R1033     | 0239 1359   | 430, 2W                                                           | ABD                     |            |
|        |             |                                            |                         |           | R1034     | 0234 8400   | 6.2K                                                              | CGW                     | C-20       |
|        |             |                                            |                         |           | R1035     | 0109 1770   | variable, wire wound, 4K, ±10% (+50V ADJ)                         | CTS                     | AW         |
|        |             |                                            |                         |           | R1036     | 0234 8420   | 7.5K                                                              | CGW                     | C-20       |
|        |             |                                            |                         |           | R1037     | 0234 8690   | 100K                                                              | CGW                     | C-20       |
|        |             |                                            |                         |           | R1038     | 0228 4020   | 11K, 3W                                                           | CGW                     | LPI-3      |
|        |             |                                            |                         |           | R1039     | 0234 8340   | 3.6K                                                              | CGW                     | C-20       |
|        |             |                                            |                         |           | R1040     | 0203 2140   | composition, 1.2M, ±10%                                           | ALB                     | EB         |
|        |             |                                            |                         |           | R1041     | 0109 1760   | variable, wire wound, 1K, (—50V ADJ)                              | CTS                     | AW         |
|        |             |                                            |                         |           | R1042     | 0234 8350   | 3.9K                                                              | CGW                     | C-20       |
|        |             |                                            |                         |           | R1043     | 0234 9200   | 4.3K, 1W                                                          | CGW                     | C-32       |
|        |             |                                            |                         |           | R1044     |             |                                                                   |                         |            |
|        |             |                                            |                         |           | & R1045   | 0234 8540   | 24K                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1046     | 0234 8030   | 180                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1047     | 0239 1359   | 430, 2W                                                           | ABD                     |            |
|        |             |                                            |                         |           | R1048     | 0234 8170   | 680                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1049     | 0234 9200   | 4.3K, 1W                                                          | CGW                     | C-20       |
|        |             |                                            |                         |           | R1050     | 0203 0420   | composition, 560                                                  | ALB                     | EB         |
|        |             |                                            |                         |           | R1051     | 0234 8490   | 15K                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1052     | 0236 7380   | 59K, ±1%                                                          | CGW                     | N-20       |
|        |             |                                            |                         |           | R1053     | 0236 6810   | 15K, ±1%                                                          | CGW                     | N-20       |
|        |             |                                            |                         |           | R1054     | 0236 5560   | 750, ±1%                                                          | CGW                     | N-20       |
|        |             |                                            |                         |           | R1055     | 0203 0420   | composition, 560                                                  | ALB                     | EB         |
|        |             |                                            |                         |           | R1056     | 0234 8450   | 10K                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1057     |             |                                                                   |                         |            |
|        |             |                                            |                         |           | & R1058   | 0234 7970   | 100                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R1059     | 0203 1720   | composition, 390, ±10%                                            | ALB                     | EB         |
|        |             |                                            |                         |           | R2001     | 0203 1120   | composition, 470K                                                 | ALB                     | EB         |
|        |             |                                            |                         |           | R2002     |             |                                                                   |                         |            |
|        |             |                                            |                         |           | & R2003   | 0234 7900   | 51                                                                | CGW                     | C-20       |
|        |             |                                            |                         |           | *R2004    |             |                                                                   |                         |            |
|        |             |                                            |                         |           | R2005     | 0234 8670   | 82K                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R2006     | 0234 8300   | 2.4K                                                              | CGW                     | C-20       |
|        |             |                                            |                         |           | R2007     | 0203 2700   | composition, 3M, ±10%                                             | ALB                     | EB         |
|        |             |                                            |                         |           | R2008     | 0234 8520   | 20K                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R2009 F,R | 0109 1910   | variable, composition, 500K/100K, ±20%, ¼W (PAT-TERN CORR/HV ADJ) | CTS                     | C2-45      |
|        |             |                                            |                         |           | R2010     | 0234 7970   | 100                                                               | CGW                     | C-20       |
|        |             |                                            |                         |           | R2011     | 0229 3630   | 2.74M, ±1%, 1W                                                    | TEX                     | CDM1       |
|        |             |                                            |                         |           | R2012     | 0229 8020   | 17M, ±1%, 2W                                                      | TEX                     | CD2R       |
|        |             |                                            |                         |           | R2013     | 0203 7340   | composition, 3.9M, 2W                                             | ALB                     | HB         |
|        |             |                                            |                         |           | R2014     | 0108 0750   | variable, composition, 2.5M, ±20% (FOCUS)                         | CLS                     | Series 37  |
|        |             |                                            |                         |           | R2015     | 0203 2130   | composition, 1M, ±10%                                             | ALB                     | EB         |
|        |             |                                            |                         |           | R2016     | 0109 0070   | variable, composition, 500K, 1W (INTENSITY)                       | CLS                     | Series 53C |
|        |             |                                            |                         |           | R2017     | 0203 0850   | composition, 36K                                                  | ALB                     | EB         |
|        |             |                                            |                         |           | R2018     | 0234 8690   | 100K                                                              | CGW                     | C-20       |
|        |             |                                            |                         |           | R2019     | 0203 2150   | composition, 1.5M, ±10%                                           | ALB                     | EB         |

Note: All resistors are fixed, film, ±5%, and ½W. Values are in ohms unless otherwise specified, K = thousand, M= million

|       |           |                                              |     |      |
|-------|-----------|----------------------------------------------|-----|------|
| R1000 | 0234 8690 | 100K                                         | CGW | C-20 |
| R1001 | 0203 2370 | composition, 150, ±20%                       | ALB | EB   |
| R1002 | 0107 2343 | variable, wire wound, 50, ±10% (SCALE ILLUM) | ABD |      |
| R1003 | 0203 2370 | composition, 150, ±20%                       | ALB | EB   |
| R1004 | 0234 8370 | 4.7K                                         | CGW | C-20 |
| R1005 | 0234 8490 | 15K                                          | CGW | C-20 |
| R1006 | 0234 8380 | 5.1K                                         | CGW | C-20 |
| R1007 | 0234 8590 | 39K                                          | CGW | C-20 |
| R1008 | 0203 0480 | composition, 1K                              | ALB | EB   |
| R1009 | 0234 8590 | 39K                                          | CGW | C-20 |

| Recommended Vendor |             |      |                                                                  |      | Recommended Vendor |           |             |                                |                                                                    |      |                            |
|--------------------|-------------|------|------------------------------------------------------------------|------|--------------------|-----------|-------------|--------------------------------|--------------------------------------------------------------------|------|----------------------------|
| Symbol             | Part Number |      | Description                                                      | Code | Type               | Symbol    | Part Number |                                | Description                                                        | Code | Type                       |
| R2021              | 0203        | 2170 | Composition, 2.2M, $\pm 10\%$                                    | ALB  | EB                 |           |             |                                |                                                                    |      |                            |
| R2022              | 0109        | 0020 | variable, composition, 500K, $\pm 20\%$ , $\frac{1}{4}W$ (ASTIG) | CTS  | Series 45 (Comm.)  |           | 2501 3210*  | Electron tube, K2130P7 (MET)   |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3220*  | Electron tube, K2130P11 (MET)  |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3230*  | Electron tube, K2130P31 (MET)  |                                                                    |      |                            |
| R2023              | 0203        | 2130 | composition, 1M, $\pm 10\%$                                      | ALB  | EB                 |           |             |                                |                                                                    |      |                            |
| R2026              | 0234        | 7970 | 100                                                              | CGW  | C-20               |           |             |                                |                                                                    |      | *Depending on sales order. |
| R2027              |             |      |                                                                  |      |                    |           |             |                                |                                                                    |      |                            |
| & R2028            | 0234        | 8690 | 100K                                                             | CGW  | C-20               |           |             |                                |                                                                    |      |                            |
| R2029              | 0234        | 8210 | 1K                                                               | CGW  | C-20               |           |             |                                |                                                                    |      |                            |
| *R2030             |             |      |                                                                  |      |                    |           |             |                                |                                                                    |      |                            |
| *R2031             |             |      |                                                                  |      |                    |           |             |                                |                                                                    |      |                            |
| R2032              | 0234        | 8340 | 3.6K                                                             | CGW  | C-20               |           |             |                                |                                                                    |      |                            |
| R2033              | 0234        | 8360 | 4.3K                                                             | CGW  | C-20               |           |             |                                |                                                                    |      |                            |
| *R2034             |             |      |                                                                  |      |                    |           |             |                                |                                                                    |      |                            |
| & R2035            |             |      |                                                                  |      |                    |           |             |                                |                                                                    |      |                            |
| TYPE 765M          |             |      |                                                                  |      |                    |           |             |                                |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    | C2007     | 0326        | 7760                           | Capacitor, fixed, ceramic, 470 pf, $\pm 20\%$ , 6000V              | RMC  | DISCAPS                    |
|                    |             |      |                                                                  |      |                    | C2020     | 0319        | 4600                           | Capacitor, fixed, paper, 0.0047 $\mu f$ , $\pm 10\%$ , 6000V       | SPG  | 184P                       |
|                    |             |      |                                                                  |      |                    | DS1001    | 1201        | 1280                           | Lamp, incandescent, miniature, 2-pin, 0.15 ampere, 6.3V            |      |                            |
|                    |             |      |                                                                  |      |                    |           |             |                                |                                                                    | GE   | No. 12                     |
|                    |             |      |                                                                  |      |                    | F1201     | 1100        | 5280                           | Fuse, 2 amperes, slow-blow                                         | LFI  |                            |
|                    |             |      |                                                                  |      |                    | HR1201    |             |                                |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    | to HR1206 | 6900        | 2511                           | Heater strip                                                       | ABD  |                            |
|                    |             |      |                                                                  |      |                    | J1001     | 0904        | 4235                           | Power line input receptacle                                        | ABD  |                            |
|                    |             |      |                                                                  |      |                    | P9001     | 0904        | 4212                           | High-voltage connector assembly                                    | ABD  |                            |
|                    |             |      |                                                                  |      |                    | R2004     | 0239        | 1407                           | Resistor, fixed, film, 27K ohms, $\pm 5\%$ , 2W                    | ABD  |                            |
|                    |             |      |                                                                  |      |                    | S1201     | 0503        | 2400                           | Thermostatic switch, 6 amperes, 125 volts ac                       | EMW  | 2200-1                     |
|                    |             |      |                                                                  |      |                    | T1001     | 2001        | 3782                           | Power transformer                                                  | ABD  |                            |
|                    |             |      |                                                                  |      |                    | V204      |             |                                |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3120*  | Electron tube, K2130P1 (REG)   |                                                                    | ABD  |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3130*  | Electron tube, K2130P2/G (REG) |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3140*  | Electron tube, K2130P2/B (REG) |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2051 3150*  | Electron tube, K2130P7 (REG)   |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3160*  | Electron tube, K2130P11 (REG)  |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3170*  | Electron tube, K2130P31 (REG)  |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3180*  | Electron tube, K2130P1 (MET)   |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3190*  | Electron tube, K2130P2/G (MET) |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3200*  | Electron tube, K2130P2/B (MET) |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3210*  | Electron tube, K2130P7 (MET)   |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3220*  | Electron tube, K2130P11 (MET)  |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501 3230*  | Electron tube, K2130P31 (MET)  |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           |             |                                |                                                                    |      | *Depending on sales order. |
| TYPE 765H          |             |      |                                                                  |      |                    |           |             |                                |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    | C2007     | 0319        | 4510                           | Capacitor, fixed, paper, #470 pf, $\pm 10\%$ , 12,500V             | SPG  | 184P-4710100               |
|                    |             |      |                                                                  |      |                    | C2010     | 0327        | 1900                           | Capacitor, fixed, mylar-kraft, 250 pf. $\pm 10\%$ , 12,500V        | CDE  | PKM 125T25                 |
|                    |             |      |                                                                  |      |                    | C2017     | 0326        | 4620                           | Capacitor, fixed, ceramic, 5000 pf, GMV, 500V                      | ERC  |                            |
|                    |             |      |                                                                  |      |                    | DS1001    | 1201        | 1280                           | Lamp, incandescent, miniature, 2-pin, 0.15 ampere, 6.3V            | GE   | No. 12                     |
|                    |             |      |                                                                  |      |                    | J1001     | 0904        | 4235                           | Power line input receptacle                                        | ABD  |                            |
|                    |             |      |                                                                  |      |                    | P9001     | 0904        | 4312                           | High-voltage connector assembly                                    | ABD  |                            |
|                    |             |      |                                                                  |      |                    | R2004     | 0239        | 1405                           | Resistor, fixed, film, 22K ohms, $\pm 5\%$ , 2W                    | ABD  |                            |
|                    |             |      |                                                                  |      |                    | R2034     |             |                                |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    | & R2035   | 0203        | 2130                           | Resistor, fixed, composition, 1M ohms, $\pm 10\%$ , $\frac{1}{2}W$ | ALB  | EB                         |
|                    |             |      |                                                                  |      |                    | T1001     | 2001        | 3782                           | Power transformer                                                  | ABD  |                            |
|                    |             |      |                                                                  |      |                    | V204      | 2501        | 3710*                          | Electron tube, KC2321P1 (MET)                                      | ABD  |                            |
|                    |             |      |                                                                  |      |                    |           | 2501        | 3720*                          | Electron tube, KC2321P2/G (MET)                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501        | 3730*                          | Electron tube, KC2321P2/B (MET)                                    |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501        | 3740*                          | Electron tube, KC2321P7 (MET)                                      |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501        | 3750*                          | Electron tube, KC2321P11 (MET)                                     |      |                            |
|                    |             |      |                                                                  |      |                    |           | 2501        | 3760*                          | Electron tube, KC2321P31 (MET)                                     |      |                            |
|                    |             |      |                                                                  |      |                    |           |             |                                |                                                                    |      | *Depending on sales order. |
|                    |             |      |                                                                  |      |                    | V205      |             |                                |                                                                    |      |                            |
|                    |             |      |                                                                  |      |                    | & V206    | 2500        | 5740                           | Electron tube, 5642                                                | EIA  |                            |

## TYPE 765M

|           |            |                                                              |     |         |
|-----------|------------|--------------------------------------------------------------|-----|---------|
| C2007     | 0326 7760  | Capacitor, fixed, ceramic, 470 pf, $\pm 20\%$ , 6000V        | RMC | DISCAPS |
| C2020     | 0319 4600  | Capacitor, fixed, paper, 0.0047 $\mu f$ , $\pm 10\%$ , 6000V | SPG | 184P    |
| DS1001    | 1201 1280  | Lamp, incandescent, miniature, 2-pin, 0.15 ampere, 6.3V      | GE  | No. 12  |
| F1201     | 1100 5280  | Fuse, 2 amperes, slow-blow                                   | LFI |         |
| HR1201    |            |                                                              |     |         |
| to HR1206 | 6900 2511  | Heater strip                                                 | ABD |         |
| J1001     | 0904 4235  | Power line input receptacle                                  | ABD |         |
| P9001     | 0904 4212  | High-voltage connector assembly                              | ABD |         |
| R2004     | 0239 1407  | Resistor, fixed, film, 27K ohms, $\pm 5\%$ , 2W              | ABD |         |
| S1201     | 0503 2400  | Thermostatic switch, 6 amperes, 125 volts ac                 | EMW | 2200-1  |
| T1001     | 2001 3782  | Power transformer                                            | ABD |         |
| V204      | 2501 3120* | Electron tube, K2130P1 (REG)                                 | ABD |         |
|           | 2501 3130* | Electron tube, K2130P2/G (REG)                               |     |         |
|           | 2501 3140* | Electron tube, K2130P2/B (REG)                               |     |         |
|           | 2051 3150* | Electron tube, K2130P7 (REG)                                 |     |         |
|           | 2501 3160* | Electron tube, K2130P11 (REG)                                |     |         |
|           | 2501 3170* | Electron tube, K2130P31 (REG)                                |     |         |
|           | 2501 3180* | Electron tube, K2130P1 (MET)                                 |     |         |
|           | 2501 3190* | Electron tube, K2130P2/G (MET)                               |     |         |
|           | 2501 3200* | Electron tube, K2130P2/B (MET)                               |     |         |
|           | 2501 3210* | Electron tube, K2130P7 (MET)                                 |     |         |
|           | 2501 3220* | Electron tube, K2130P11 (MET)                                |     |         |
|           | 2501 3230* | Electron tube, K2130P31 (MET)                                |     |         |

## TYPE 765H

|         |            |                                                                    |     |              |
|---------|------------|--------------------------------------------------------------------|-----|--------------|
| C2007   | 0319 4510  | Capacitor, fixed, paper, #470 pf, $\pm 10\%$ , 12,500V             | SPG | 184P-4710100 |
| C2010   | 0327 1900  | Capacitor, fixed, mylar-kraft, 250 pf. $\pm 10\%$ , 12,500V        | CDE | PKM 125T25   |
| C2017   | 0326 4620  | Capacitor, fixed, ceramic, 5000 pf, GMV, 500V                      | ERC |              |
| DS1001  | 1201 1280  | Lamp, incandescent, miniature, 2-pin, 0.15 ampere, 6.3V            | GE  | No. 12       |
| J1001   | 0904 4235  | Power line input receptacle                                        | ABD |              |
| P9001   | 0904 4312  | High-voltage connector assembly                                    | ABD |              |
| R2004   | 0239 1405  | Resistor, fixed, film, 22K ohms, $\pm 5\%$ , 2W                    | ABD |              |
| R2034   |            |                                                                    |     |              |
| & R2035 | 0203 2130  | Resistor, fixed, composition, 1M ohms, $\pm 10\%$ , $\frac{1}{2}W$ | ALB | EB           |
| T1001   | 2001 3782  | Power transformer                                                  | ABD |              |
| V204    | 2501 3710* | Electron tube, KC2321P1 (MET)                                      | ABD |              |
|         | 2501 3720* | Electron tube, KC2321P2/G (MET)                                    |     |              |
|         | 2501 3730* | Electron tube, KC2321P2/B (MET)                                    |     |              |
|         | 2501 3740* | Electron tube, KC2321P7 (MET)                                      |     |              |
|         | 2501 3750* | Electron tube, KC2321P11 (MET)                                     |     |              |
|         | 2501 3760* | Electron tube, KC2321P31 (MET)                                     |     |              |

\*Depending on sales order.



| Symbol    | Part Number | Description                                                 | Recommended Vendor |                 | Symbol        | Part Number | Description                                                        | Recommended Vendor |                            |
|-----------|-------------|-------------------------------------------------------------|--------------------|-----------------|---------------|-------------|--------------------------------------------------------------------|--------------------|----------------------------|
|           |             |                                                             | Code               | Type            |               |             |                                                                    | Code               | Type                       |
| TYPE 767H |             |                                                             |                    |                 | R2004         | 0239 1405   | Resistor, fixed, film, 22K ohms, $\pm 5\%$ , 2W                    | ABD                | EB                         |
| C2007     | 0319 4510   | Capacitor, fixed, paper, 470 pf, $\pm 10\%$ , 10,000V       | SPG                | 184P<br>4710100 | R2023         | 0203 2130   | Composition, 1M, $\pm 10\%$                                        | ALB                |                            |
|           |             |                                                             |                    |                 | R2034 & R2035 | 0203 2130   | Resistor, fixed, composition, 1M ohms, $\pm 10\%$ , $\frac{1}{2}W$ | ALB                |                            |
| C2010     | 0327 1900   | Capacitor, fixed, mylar-kraft, 250 pf, $\pm 10\%$ , 12,500V | CDE                | PKM 125T25      | T1001         | 2001 3782   | Power transformer                                                  | ABD                | EB                         |
| C2017     | 0326 4620   | Capacitor, fixed, ceramic, 5000 pf, GMV, 500V               | ERC                |                 | V204          | 2501 3710*  | Electron tube, KC2321P1 (MET)                                      | ABD                |                            |
|           |             |                                                             |                    |                 |               | 2501 3720*  | Electron tube, KC2321P2/G (MET)                                    |                    |                            |
| DS1001    | 1201 2340   | Lamp assembly                                               | DRK                | Part #121-7     |               | 2501 3730*  | Electron tube, KC2321P2/B (MET)                                    |                    | *Depending on sales order. |
| J1001     | 0904 4236   | Power line input receptacle                                 | ABD                |                 |               | 2501 3740*  | Electron tube, KC2321P7 (MET)                                      |                    |                            |
| J2001     | 0905 6710   | Jack tip, green                                             | JHN                | 108             |               | 2501 3750*  | Electron tube, KC2321P11 (MET)                                     |                    |                            |
| J2002     | 0905 6700   | Jack tip, black                                             | JHN                | 108             |               | 2501 3760*  | Electron tube, KC2321P31 (MET)                                     |                    |                            |
| P9001     | 0904 4312   | High-voltage connector assembly                             | ABD                |                 |               |             |                                                                    |                    |                            |
|           |             |                                                             |                    |                 | V205 & V206   | 2500 5740   | Electron tube, 5642                                                | EIA                |                            |

## LIST OF RECOMMENDED VENDORS

| CODE | NAME                                        | CODE | NAME                                     |
|------|---------------------------------------------|------|------------------------------------------|
| ABD  | Allen B. Du Mont Laboratories               | GUD  | The Gudemann Company                     |
| AER  | Aerovox Corporation                         | HOP  | Hopkins Engineering Company              |
| AHH  | Arrow-Hart & Hegeman Electric Company       | HWP  | Hewlett-Packard Company                  |
| ALB  | Allen-Bradley Company                       | IRC  | International Resistance Company         |
| ALC  | Allied Control                              | IRP  | International Rectifier Corporation      |
| ALD  | Alden Products Company                      | ITT  | ITT Components Division                  |
| AMA  | Amaton Electronic Hardware                  | JEF  | Jeffers Electronics, Inc.                |
| AMP  | Amp Inc.                                    | JHN  | E. F. Johnson Company                    |
| AMR  | Amperite Company, Inc.                      | JWM  | J. W. Miller Co.                         |
| AMX  | Amperex Electronic Products, Inc.           | KUL  | Kulka Electric Mfg. Co. Inc.             |
| APC  | American Phenolic Corporation               | KXM  | Klixon Metals and Control Corporation    |
| APH  | Amphenol Electronics Corporation            | LFI  | Littlefuse, Inc.                         |
| ARC  | Arco-Elmenco                                | MAL  | P. R. Mallory & Company, Inc.            |
| AST  | Astron Corporation                          | MIC  | Micamold Electronics Mfg. Corporation    |
| BUS  | Bussmann Mfg. Co.                           | MIL  | Miller Electric Company                  |
| CAN  | Cannon Electric Company                     | MUT  | The Muter Company                        |
| CBS  | CBS-Hytron Division of CBS                  | NYT  | New York Transformer Company, Inc.       |
| CGW  | Corning Glass Works                         | OAK  | Oak Mfg. Company                         |
| CH   | Cutler-Hammer, Inc.                         | PHC  | Philco Corporation                       |
| CHC  | Chester Cable Corporation                   | PHI  | Phillips Electronic Tube Division        |
| CHM  | Chatham Electronics                         | PLS  | Plastoid Corporation                     |
| CLS  | Clarostat Mfg. Co., Inc.                    | POT  | Potter & Brumfield, Inc.                 |
| CDE  | Cornell-Dubilier Electric Corporation       | PRC  | Precision Resistor Co., Inc.             |
| COC  | Continental Carbon                          | PYR  | Pyramid Electric Company                 |
| CPC  | C. P. Clare & Company                       | RCA  | Radio Corporation of America             |
| CRL  | Centralab, Division of Globe-Union Inc.     | RCM  | Radio Materials Corporation              |
| CST  | Chicago Standard Transformer                | ROY  | Royal Electric Corp., Inc.               |
| CTS  | Chicago Telephone Supply Corporation        | RTN  | Rotron Mfg. Company                      |
| DAG  | Dage Electric Company, Inc.                 | SLT  | Sealectro Corporation                    |
| DAL  | Dale Products, Inc.                         | SPG  | Sprague Electric Company                 |
| DLC  | Dialight Corporation                        | STC  | Stackpole Carbon Company                 |
| DRK  | Drake Mfg. Co.                              | STW  | Standard Winding Company                 |
| EBY  | Hugh H. Eby, Inc.                           | SUM  | Summit Coil Company                      |
| EIA  | Any manufacturer meeting EIA standards      | SYL  | Sylvania Electric Products, Inc.         |
| ELC  | Electra Mfg. Company                        | SYN  | Synstronic Instruments, Inc.             |
| ELD  | Eldema Corporation                          | TEC  | Transistor Electronics Corporation       |
| ELM  | Elmenco                                     | TEX  | Texas Instruments, Inc.                  |
| EMC  | Electro Motive Mfg. Company                 | THC  | Thermol Control, Inc.                    |
| EMW  | Elmwood Sensors, Inc.                       | TOR  | Torrington Mfg. Company                  |
| ER   | Eastern Radio                               | TRS  | Tresco, Inc.                             |
| ERC  | Erie Resistor Corporation                   | TRU  | Tru-Ohm Products                         |
| ESX  | Essex Electronics                           | TUG  | Tung-Sol Electric Inc.                   |
| FCI  | Fairchild Camera and Instrument Corporation | UCN  | Ucinite Co.                              |
| FER  | Ferroxcube Corporation of America           | VIC  | The Victoreen Instrument Company         |
| GE   | General Electric Company                    | WDL  | Ward Leonard Electric Company            |
| GRC  | General Radio Company                       | WES  | Weston Electrical Instrument Corporation |
| GRY  | Grayhill, Inc.                              | WYN  | Welwyn International Inc.                |



# **DU MONT**

## **INSTRUMENT WARRANTY AND SERVICE NOTICE**

### **WARRANTY**

Allen B. Du Mont Laboratories warrants that each new Cathode-ray Oscilloscope, Automotive Test Equipment, and other Electronic or Electrical Test or Measuring Equipment (hereinafter referred to as "Instrument") manufactured or sold by it, is free from defects in material or workmanship under normal use and service for a period of one year from the date of its sale to the first purchaser for use. If, upon examination by Du Mont, the Instrument is determined to be defective in workmanship or material, Du Mont will, subject to the conditions set forth below, either repair the defective part or replace it with a new part. Du Mont shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from any governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall Du Mont be liable for damages by reason of the failure of the Instrument to perform properly or for any consequential damages. This warranty does not apply to any Instrument that has been subject to negligence, accident, misuse or improper installation or operation or that in any way has been tampered with, altered or repaired by any person other than an authorized Du Mont service organization or an employee thereof, or to any Instrument whose serial number has been altered, defaced or removed, or to any Instrument purchased within, and thereafter removed beyond, the continental limits of the United States.

This warranty shall, at Du Mont's option, become void unless registration thereof is promptly effected as provided below. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of Du Mont or impose any obligation upon it in connection with the sale of any Instrument, other than as stated above.

### **REGISTERING THE WARRANTY**

To register this warranty, the enclosed warranty registration card must be properly filled out and mailed to the Instrument Service Department immediately upon receipt of the equipment. Complete information is necessary. **BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD.** Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

### **CHANGES IN SPECIFICATIONS**

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

### **SERVICE**

In order to insure service under our warranty, the enclosed warranty service card must be properly filled out and returned to the factory. In all cases where service or adjustment is requested, please first contact the factory or authorized depot, giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. **THE TYPE NUMBER AND SERIAL NUMBER** of the equipment must also be given. In this way, much time can be saved and unnecessary inconvenience often avoided. When writing to the factory in this respect, address:

#### **ALLEN B. DU MONT LABORATORIES**

Divisions of Fairchild Camera and Instrument Corporation

#### **Industrial Electronics Division**

**750 Bloomfield Avenue, Clifton, New Jersey**

The Instrument Service Department will then send to the customer the written procedure for disposition and shipping instructions. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

### **REPLACEMENT PARTS**

If it is necessary to order a replacement component from the factory, always give the Type number and Serial number of the Instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in the Instruction Manual. The Parts List gives the values, tolerances, ratings, and Du Mont part number for all electrical components used in the Instrument. This will help to expedite service.

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**750 Bloomfield Avenue, Clifton, New Jersey**

### **PATENT NOTICE**

Manufactured under one or more U. S. Patents owned or controlled by Allen B. Du Mont Laboratories, Divisions of Fairchild Camera and Instrument Corporation, 750 Bloomfield Avenue, Clifton, New Jersey, U.S.A. Patent Numbers supplied upon request.



1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUE ARE IN  $\mu$ F UNLESS OTHERWISE SPECIFIED
3.  SERVICE ADJUSTMENT.
4.  INDICATES HEAT SINK.
5. WHEN THE 115V/230V SELECTOR SWITCH (S10) IS SET FOR 115V OPERATION, HEATERS MUST BE WIRED PER OPTION "A"; FOR 230V OPERATION, OPTION "B"

MEASUREMENTS TAKEN AT  
MID-LINE VOLTAGE WITH  
FULL LOAD



